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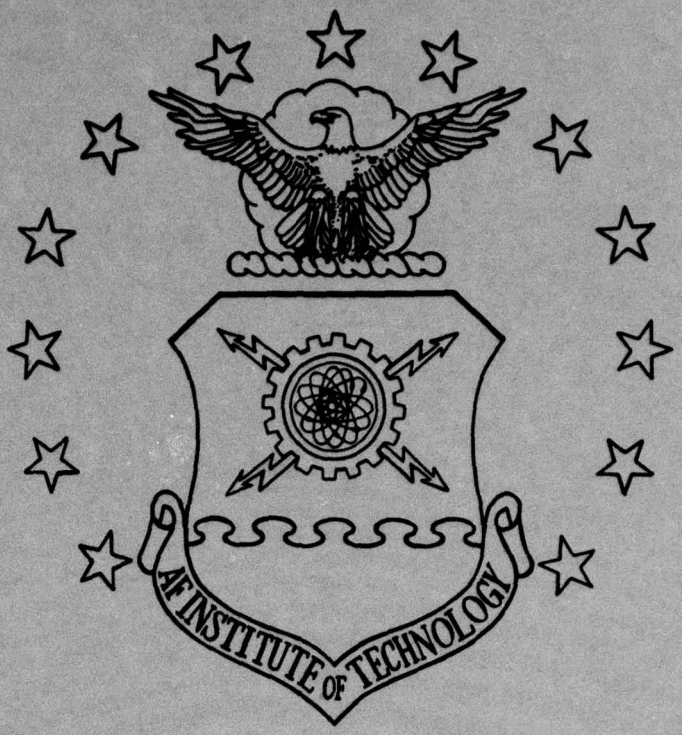

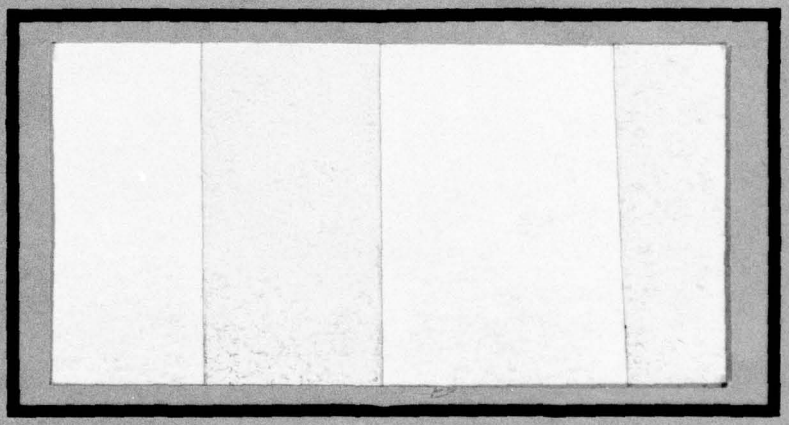

UNITED STATES AIR FORCE

AIR UNIVERSITY

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Wright-Patterson Air Force Base, Ohio

A STATISTICAL ANALYSIS TO DETERMINE THE SUPPLY EFFECTIVENESS OF THE COOPERATIVE LOGISTICS SUPPLY SUPPORT ARRANGEMENT (CLSSA) PROGRAM

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LSSR 3-79B

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This thesis provides an explanation of the supply aspects of the Cooperative Logistics Supply Support Arrangement (CLSSA). A statistical and operational analysis is made of the fill times for programmed and nonprogrammed requisitions and requisitions containing Not Mission Capable-Supply (NMCS) indicators. Select data obtained from the HO51 computer data files forms a basis for the analysis. The analysis indicates that the mean fill times for programmed requisitions are statistically less than fill times for comparable nonprogrammed requisitions. Further, NMCS requisitions were found to receive no better support if coded as programmed. The thesis concludes that the differences in fill times for programmed and nonprogrammed requisitions, while statistically significant, fails to meet established criteria.

LSSR 3-79B

A STATISTICAL ANALYSIS TO DETERMINE THE SUPPLY EFFECTIVENESS OF THE COOPERATIVE LOGISTICS SUPPLY SUPPORT ARRANGEMENT (CLSSA) PROGRAM

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

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September 1979

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has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degrees of

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CHAPTER I

INTRODUCTION

The Security Assistance Program is a Department of Defense initiative developed to administer the gift and sale of military equipment and services to friendly foreign governments in accordance with law and national policy directives (25:A-1). Subprograms of the Security Assistance Program are the Military Assistance Program (MAP) and Foreign Military Sales (FMS). MAP deals primarily with grants and was formerly called Grant Aid. FMS involves the selling of military equipment and services to friendly foreign governments. Grant Aid played a major role in Security Assistance following World War II with Foreign Military Sales developing as the predominant form of Security Assistance during the last decade.

A review of the statistics since 1969 highlights the evolution that the Security Assistance Program has undergone in a transition from an emphasis on Grant Aid to Foreign Military Sales. Figure 1-1 illustrates this evolution (27:4,19,25). From 1969 to 1973 MAP was substantially larger in dollar terms than FMS. The MAP position can be explained in part by our support to the Republic of Vietnam. In 1974 our support to Vietnam decreased

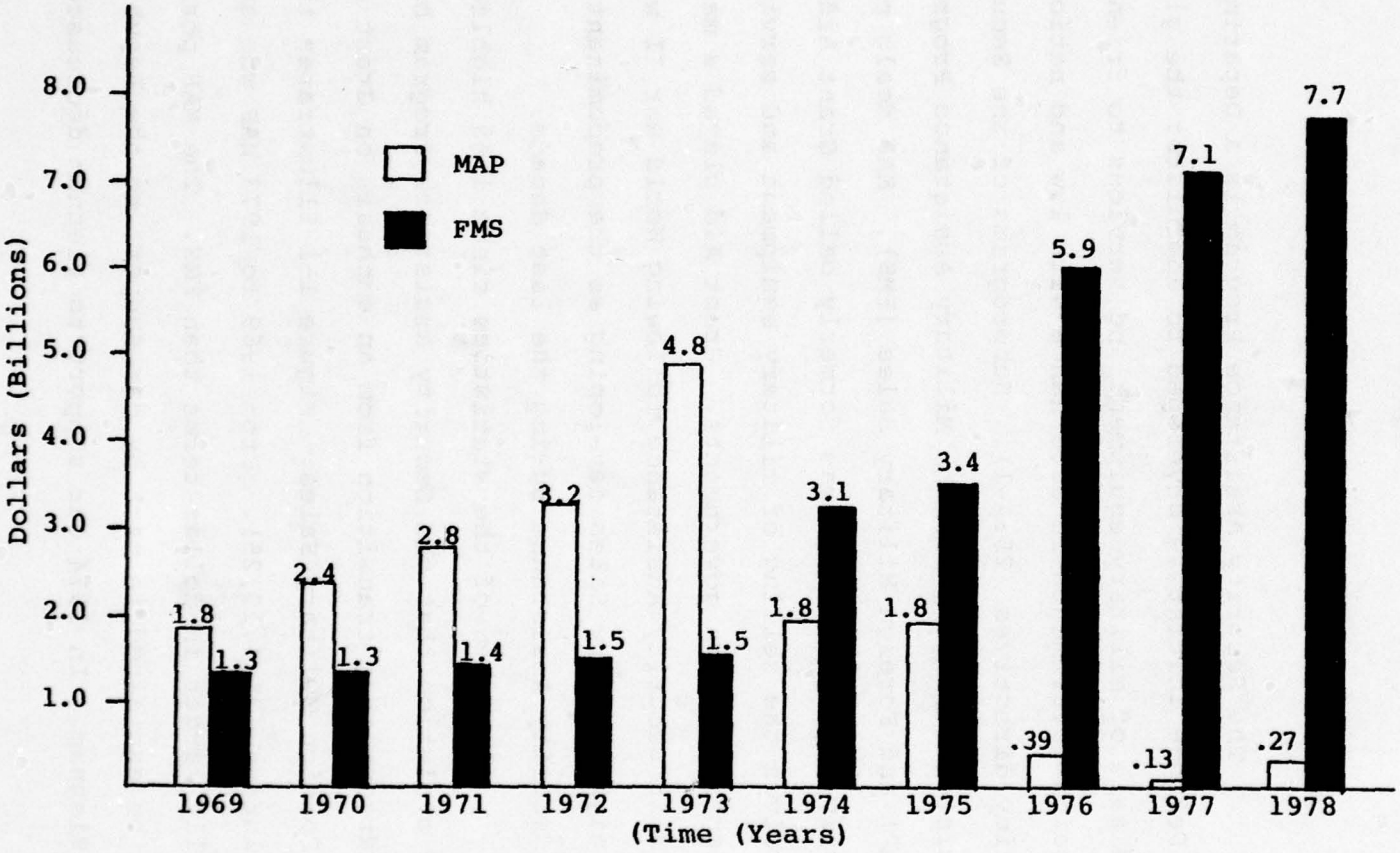


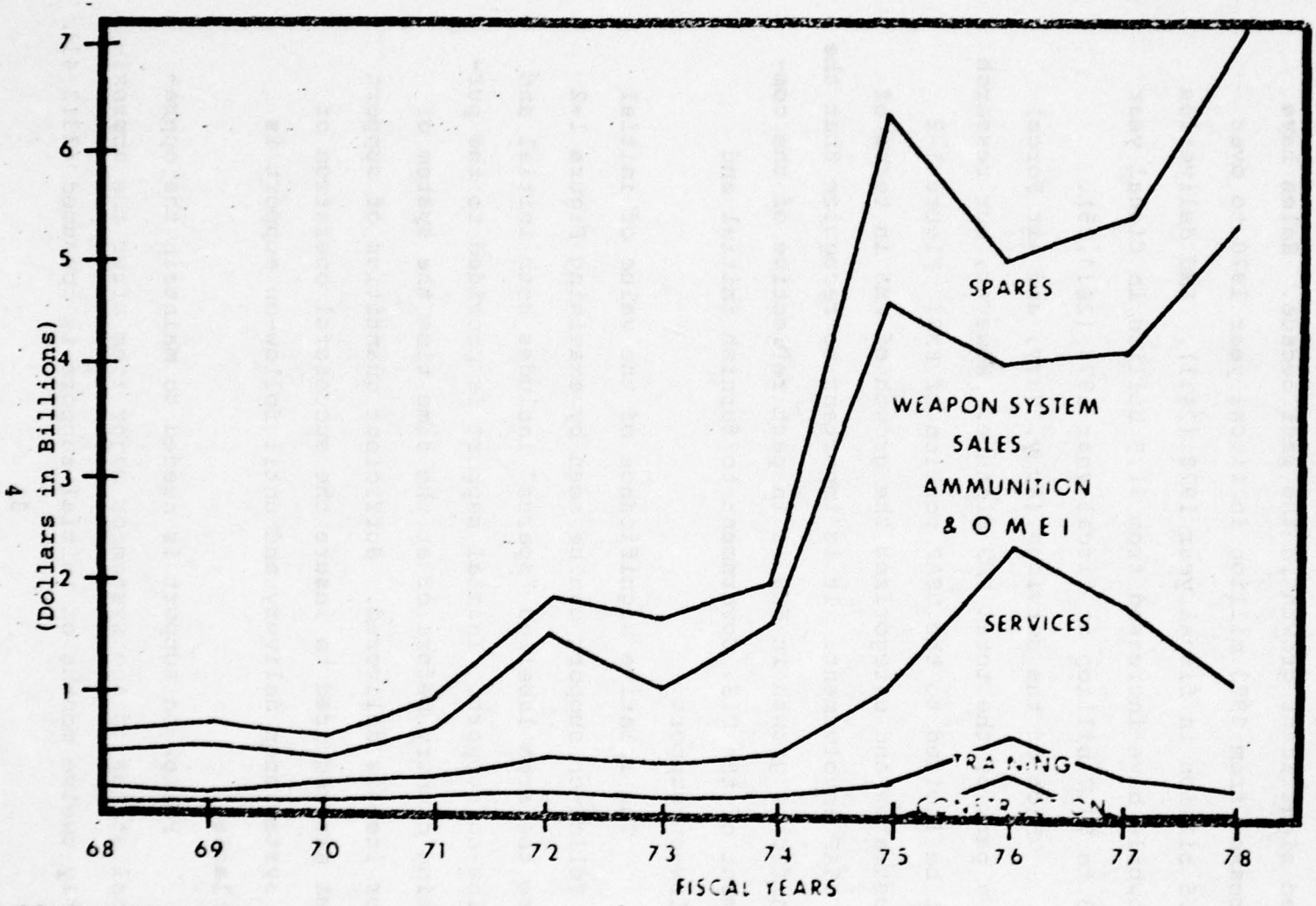
Fig. 1-1. Grant and FMS Deliveries (26:4,19,25)

significantly and ended in 1975 (26:19). FMS has experienced significant growth in the past decade. Sales have increased from $953 million in fiscal year 1970 to over $13.5 billion in fiscal year 1978 (26:1). FMS deliveries meanwhile have increased from $1.5 billion in fiscal year 1973 to $7.7 billion in fiscal year 1978 (26:4,25).

Each of the services (Army, Navy, and Air Force) are a part of the total FMS picture. However, our research will be limited to the USAF portion of FMS. Figure 1-2 illustrates and categorizes the growth of FMS in terms of the USAF involvement. It is important to recognize that the significant growth in FMS is in part reflective of the commitment of the U.S. Government to furnish initial and follow-on support.

The relative significance of the value of initial and follow-on support can be seen by examining Figure 1-2 where the area labelled "spares" includes both initial and follow-on support. Initial support is provided to the purchasing country before or at the same time the system of major item is delivered. Sufficient quantities of support items are required to insure the successful operation of the system upon delivery and until follow-on support is available.

Follow-on support is needed to maintain the operational status of the system or major item after the approximately twelve months of initial support is consumed (23:3-41).



SOURCE DSAA WEAPONS ANALYSIS REPORT FMSI

AS OF DEC 1978

Fig. 1-2. USAF FMS

The introduction of large quantities of new, sophisticated weapon systems has increased the need for a responsive logistics support program for FMS countries (9:1).

There are three ways that FMS countries can obtain follow-on support: (1) Firm Order Case; (2) Blanket Order Case; and (3) Cooperative Logistics Supply Support Arrangement (CLSSA). A Firm Order Case is a one-time sales contract for a definitive depth and range of items. A Blanket Order Case is established for a dollar amount without specifying the items or quantities to be provided. Because the placement of defense articles in new or existing overseas stockpiles is limited to an amount specified in annual Security Assistance legislation (29:1,2), the FMS country is normally lead time away from delivery for both Firm Order and Blanket Order requisitions (16:26).

CLSSA is a program designed to provide participating FMS customer countries a means of obtaining priority follow-on support. The purpose of CLSSA is to enable the participating countries to utilize the USAF logistics system to obtain support for mutually agreed-upon weapon systems and mission-related items of U.S. origin (21:A29-4). Requisitions submitted by FMS customers under the CLSSA program are designated as either programmed or nonprogrammed.[1] Programmed requisitions are given access to on-hand

[1]A more complete explanation of terms peculiar to FMS such as programmed and nonprogrammed is contained in the Glossary and in Chapter II.

depot stocks while nonprogrammed requisitions will be back-ordered lead-time away. Conceptually, programmed requisitions benefit from shorter fill times when compared to nonprogrammed requisitions.

CLSSA is the preferred USAF method of providing follow-on FMS supply support. In fact, the negotiation of follow-on CLSSAs is a condition of sale for weapon systems (23:4-30). This preference relates to the USAF's goal of providing timely delivery of material and services to FMS countries without jeopardizing the supply needs of the USAF (23:3-1). A detailed discussion of the CLSSA program is provided in Chapter II.

Participation in the CLSSA program has paralleled the growth of FMS. CLSSA has grown from 13 countries and 50.5 million dollars in 1971 to 33 countries and approximately 366.7 million dollars as of June 1979 (17). Figure 1-3 illustrates recent dollar statistical regarding the CLSSA Program (17).

Problem Statement

Foreign countries are given to understand that one of the greatest advantages of CLSSA is that supply support can be provided in a most timely manner and on the same priority as that being provided equivalent U.S. forces performing comparable missions (27:F-1). Further, the Military Assistance Sales Manual (MASM) states that "The country

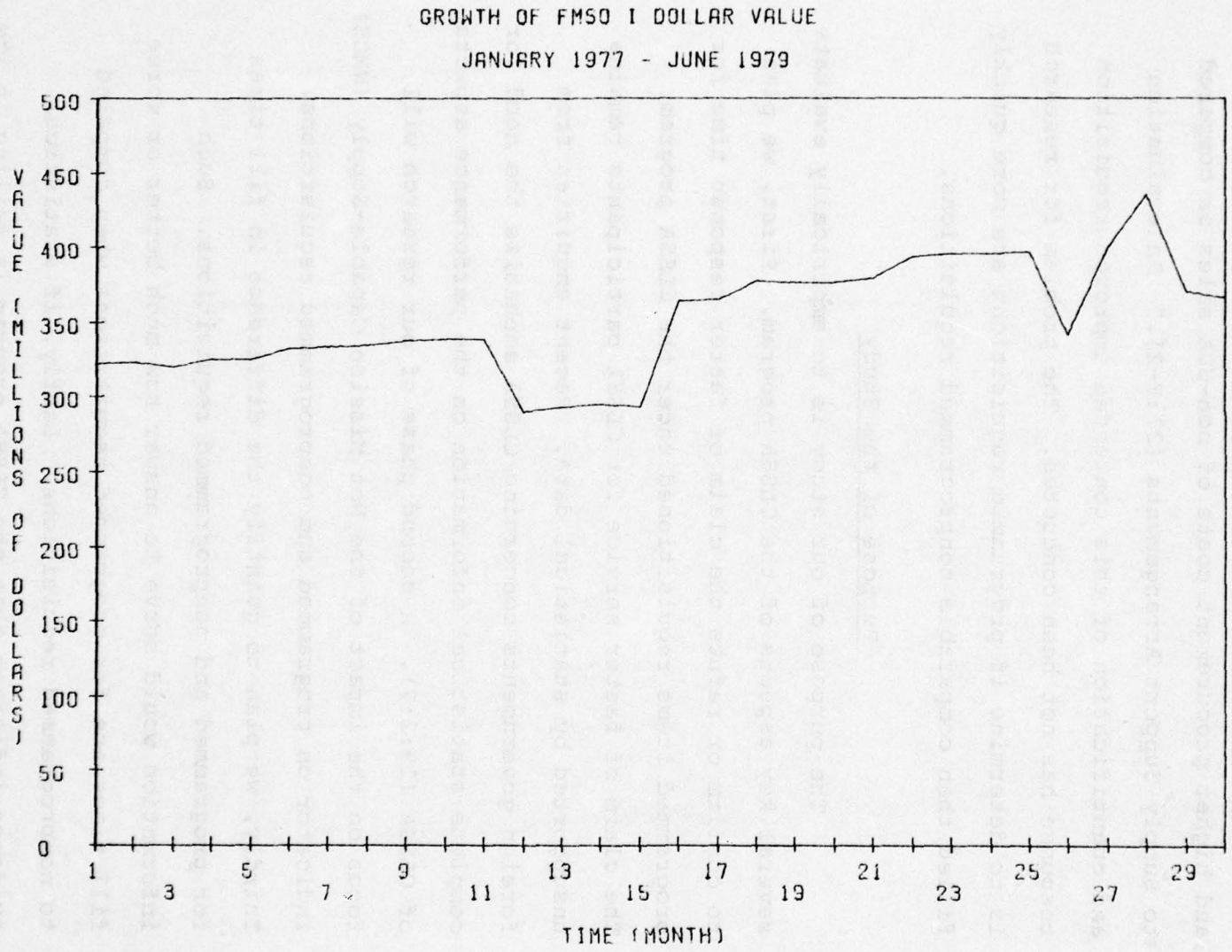


Fig. 1-3. Growth of FMS Cases (17)

should be made fully aware of the normally longer lead time and higher procurement costs of non-SSA sales as compared to Supply Support Arrangements [27:F-2]." An evaluation and quantification of this contended improved requisition response has not been conducted. The problem for research is to determine if programmed requisitions are more quickly filled than comparable nonprogrammed requisitions.

Purpose of the Study

The purpose of our study is to empirically evaluate several key aspects of the CLSSA program. First, we plan to confirm or refute the claim of faster response time for programmed items requisitioned under the CLSSA program. The claim of faster service for CLSSA participants remains unsupported by statistical data. Recent enquiries from foreign governments concerning CLSSA emphasize the need for complete statistical information on the performance aspects of CLSSA (19:2:7). A second phase of our research will focus on the impact of the Not Mission Capable-Supply (NMCS) indicator on programmed and nonprogrammed requisitions. Thirdly, we plan to quantify the difference in fill times for programmed and nonprogrammed requisitions. Such information would serve to answer how much better or worse fill times are for programmed requisitions when compared to nonprogrammed requisitions. Lastly, if statistical evidence indicates that the CLSSA program is failing in its

claim of faster response time, we plan to investigate the reasons for the failure.

Related Research

Though there are a number of DOD, USAF, and AFLC-ILC publications and regulations which define and describe the objectives, mechanisms, and organizational responsibilities associated with the CLSSA program, little research has been done in evaluating the supply performance of the CLSSA program. A synopsis of recent studies relative to CLSSA support is provided below.

Myers and O'Grady Statistics Project

Myers and O'Grady (13) conducted preliminary research analyzing requisition fill times for CLSSA cases (K cases) and blanket order cases (R cases). Their problem statement addressed the fact that:

> There does not currently exist a practical procedure whereby it can be determined whether SSA countries are in fact receiving better support for their investment than non-SSA countries [12:1].

and their conclusion contended that:

> . . . at least for the requisitions reviewed, participating cooperating logistics customers are not receiving significantly better support than nonparticipating countries [12:15].

In our opinion, their research methodology was deficient in a number of areas. These deficiencies negated a proper addressing of their problem statement and invalidated their results. Specific deficiencies in their

methodology included: (1) implicitly considering all requisitions submitted under a "K" case as programmed; (2) making no attempt to ensure that the sample of "R" case and "K" case requisitions that they compared were against like items; and (3) using the Julian date of when the country prepared the requisition as opposed to the HO51 receipt date in their fill time computations.

Though their results were not formally published, a nontechnical management briefing of their findings was presented to ILC personnel. The conclusion of their study that there was no improvement of support for CLSSA customers generated significant concern within the ILC. This concern was a primary reason for our decision to conduct our research.

Myers and O'Grady Thesis

Myers and O'Grady's thesis work (12) provides an excellent outline of the CLSSA program addressing in detail: (1) the USAF functional organization associated with the CLSSA program; (2) the logistics procedures involved in the execution of the program; and (3) the financial operations of the program. Though no assessment of CLSSA was attempted, their work provides a clear description of the many elements of the CLSSA program.

Pendly and Ratley Thesis

Pendly and Ratley (18) have just recently (1979) completed research work on the supply performance of the CLSSA program. The aim of their thesis was to:

> . . . provide the critical research necessary to definitively evaluate the effectiveness of CLSSA by comparing programmed and nonprogrammed requisition response time [18:29].

Their effort examined FMS requisitions for USAF recoverable items and for USAF critical items. Critical items are those NSNs which require special management attention because of their acute short supply position and their significant impact on the mission capability of a weapon system(s).

Their results corroborated the conclusions drawn by Myers and O'Grady that programmed demands received no better treatment than nonprogrammed demands (18:74). Their results relative to requisitions for critical items, however, did indicate a significant improvement in fill times for programmed requisitions over nonprogrammed requisitions (18:73).

Though their research methodology avoided the deficiencies of the Myers and O'Grady effort, a few points require discussion. Their research design requires a considerable amount of manual data collection, editing, and reformatting which does not lend itself to ease of replication (18:39-40). Also, their sample size of 60 NSNs may

not be adequate for purpose of making statistical inferences. In considering independent variables which may influence the fill time of a requisition, they did investigate the procurement lead time of the item but did not consider the quantity on the requisitions as a possibly significant variable.

The most significant difference in their effort versus ours involves addressing the question of why the differences in support are not significant. Pendly and Ratley could only speculate on some possible causes of the "apparent failure of the AFLC logistics system to provide differentiated support to programmed and nonprogrammed FMS requisitions based on our research [18:75]." Our thesis will specifically investigate this "apparent failure" if our data analysis reaches the same conclusion.

Breed and Winn Thesis

Breed and Winn (2) are currently examining the CLSSA program in terms of its contended but unvalidated claim of pricing benefits for participating FMS countries. The objective of their research is: "To compare final billing prices for programmed and nonprogrammed requisitions to determine if a significant price differential exists [2:7]."

Research questions which their effort addresses include:

1. Is there a difference in the actual procedures for determining billing prices for programmed and nonprogrammed requisitions?
2. Have prescribed pricing procedures effectively been implemented for processing CLSSA programmed and nonprogrammed requisitions [2:8]?

The preliminary results of their research indicate that the majority of the final billing prices for programmed requisitions are not significantly less than comparable nonprogrammed requisitions.

Reports

There are two computer reports which display support fill time statistics regarding programmed and nonprogrammed requisitions. Specifically, the HO51.WE1A report (7) computes and displays a number of fill time statistics (e.g., mean, mode, median). The MOO4.AOOY report (15), a product of the Reporting Analysis Planning System (RAPS) run for selected FMS countries, contains a breakout of fill times for programmed and nonprogrammed requisitions. In our judgement, the data presented on these reports are not equivalent and the statistics portrayed are therefore distorted and misleading.

Justification

An evaluation of the fill times of programmed versus nonprogrammed requisitions would be useful in a number of ways: (1) USAF negotiators would be able to use the comparative statistics as a substantial advantage to

induce non-CLSSA FMS countries to participate in the program; (2) International Logistics Center (ILC) personnel could use the evaluation techniques developed to periodically monitor the responsiveness of the CLSSA program; and (3) the evaluation techniques could be used to identify specific supply problem situations and initiate corrective management action. Without this evaluation, statements regarding improved support through CLSSA will remain undocumented, unsubstantiated, and possibly untrue. ILC personnel have indicated that they would be most interested in our CLSSA analysis (17).

The need for more accurate statistical information on the CLSSA program was underscored in recent correspondence from HQ PACAF to the ILC. HQ PACAF requested statistical information on the average percentage of backorders on programmed requisitions and the average fill time for programmed requisitions (19:1). The ILC response was:

> We realize that statistical data of the type you requested should be available for the analysis of the CLSSA program. As you are aware, data processing capability for FMS research purposes is virtually nonexistent. . . . We are working with AFIT students who are doing their thesis work on the advantages of the CLSSA program. . . . Without available data to statistically support the CLSSA program your explanations will necessarily be limited to the theoretical advantages [10:1].

The Japanese Air Self Defense Force (JASDF) has recently expressed interest in participating in the CLSSA

program and has requested supply performance information to help justify their decision to the Japanese Defense League (8). Our analysis should help provide CLSSA supply performance information to assist the JASDF in their justification. The communication from the JASDF emphasizes the necessity of maintaining statistical information on key aspects of the CLSSA program. The periodic and in-depth evaluation of appropriate CLSSA statistical data would allow a rapid response to inquiries and provide indicators of the success of the CLSSA program.

Scope

Our analysis is limited to service code "A" national stocknumbers (NSN), (i.e., USAF managed recoverable items) which have experienced both programmed and nonprogrammed requisition activity. The rationale for limiting our research to service code "A" items is that these items are the key items essential to maintaining the availability of a weapon system. Service code "A" items are also the most expensive items and have long lead times. Another important reason for limiting our research to service code "A" items is that these items are the ones for which AFLC has responsibility and authority to establish inventory policy and control stock levels. Thus, our research is directed to those items over which policy and control can be exercised.

The rationale for selecting only NSNs with both programmed and nonprogrammed requisition activity is to ensure that NSNs with similar supply characteristics are being compared. The NSNs placed on a CLSSA would, in general, be items which are not readily available from stock and or which have a significant effect on the availability of the weapon system.

Faster requisition time is particularly important when the availability of a weapon system is impaired or anticipated to be impaired by an out-of-stock position. Consequently, we paid particular attention to requisitions coded with a Not Mission Capable-Supply (NMCS) indicator. The five specific objectives of our research are summarized below.

Research Objectives and Hypothesis

Objective 1--to provide an explanation of the supply aspects of the CLSSA program.

Objective 2--to test the hypothesis that programmed requisitions for AF investment items do, in fact, receive faster processing time than similar nonprogrammed requisitions.

Objective 3--to test the hypothesis that programmed NMCS requisitions for AF investment items do, in fact, receive faster processing time than similar nonprogrammed NMCS requisitions.

Objective 4--if objectives 2 and 3 are supported, to quantify the magnitude of the improved support.

Objective 5--if objectives 2 and 3 cannot be supported, to determine why the AFLC logistics system is failing to provide a better level of support for programmed requisitions.

Definition of Terms

Acceptance Date--the date which appears on the acceptance portion of DD Form 1513 and indicates the calendar date on which a foreign buyer agrees to accept the items and conditions contained in the FMS offer portion [21:v].

Acceptance and Letter of Offer--U.S. Department of Defense (DD) Form 1513 Offer and Acceptance by which the U.S. Government offers to sell to a foreign government or international organizations defense articles and defense services pursuant to the Arms Export Control Act, as amended. The DD Form 1513 lists the items and/or services, estimated costs, the terms and conditions of sale, and provides for the foreign government's signature to indicate acceptance [21:5].

Accessorial Charges--a separate charge added to the sale of material to cover expenses associated with the preparation and delivery of the materiel [21:v].

Administrative Charges--charges associated with the administration of the defense logistics system. For FMSO I administrative charges are 5% of the on-hand inventory (5/17 of materiel value) and for FMSO II, 3% of materiel value [21:v].

Backorder--a requisition being held at a supply point pending some positive supply action [21:v].

Blanket Order FMS Case--a case established for a category of items or services with no definitive listing of specific items or quantities. The case specified a dollar ceiling against which the purchaser may place orders throughout the validity period defined in the case [21:v].

Case--a contractual sales agreement between the U.S. and an eligible foreign country or international organization documented by DD Form 1513. One FMS case designator is assigned for the purpose of identification, accounting and data processing for each accepted offer [21:v].

Case Designator--a unique designator assigned by the implementing agency to each Foreign Military Sales case. The designator originates with the offer of a sale, identifies the case through all subsequent transactions, and is generally a three letter designation.

Cooperative Logistics Supply Support Arrangement--the arrangement under which logistics support is provided to a foreign government through its participation in the U.S. Department of Defense logistics system with reimbursement to the U.S. for support performed [21:vi].

Dependable Undertaking--a firm commitment made by a foreign government or international organizations to:

a. Pay the full cost of articles and services provided, and assure the U.S. against any loss on a contract for new production items or the performance of defense services.

b. Make funds available in such amounts and at such times as may be required to meet payments required by contract, or for services performed or for any damages and costs that may accrue from the cancellation of such contract in advance of the time such payment, damages or costs are due [21:vi].

DO32--the Item Manager Stock Control and Distribution System. A uniform item management system for property accounting, inventory control, and distribution of worldwide material.

Follow-on Support--recurring support required to maintain the operational status of the system/major item [21:vi].

Force Activity Designator--designators assigned by Joint Chiefs of Staff for all customer countries. The FAD is shown as a Roman numeral (I through V) [21:vi].

Foreign Military Sales--the selling of military equipment and services to friendly foreign governments and international organizations under the authority of the Foreign Military Sales Act of 1968, as amended [21:vii].

Foreign Military Sale Order No. 1 (FMSO 1)--provides for pipeline capitalization of a CLSSA, which consists of stock "on hand" and replenishment of stocks "on order" in which the participating country buys equity in the U.S. supply system for support of a specific weapons system [21:vii].

Foreign Military Sales Order No. 2 (FMSO II)--provides for the withdrawal of spares and repair parts from the DOD inventory [21:vii].

FMS Trust Fund--money received from a foreign country or international organization and held in trust pending a requirement by the military departments [21:vii].

HO51--the HO51 computer system is a part of a large AFLC Automatic Data Processing (ADP) network which interfaces with other DOD ADP systems and foreign countries. After processing and recording information, it provides products for International Logistics program management, triggers other AFLC and DOD systems to initiate supply actions, and provides the reporting mechanism to all the case managers to ensure that actual supply of material and services is accomplished.

Investment Item--item that can be repaired and reissued. Also referred to as reparable item and recoverable item. These items are ERRC coded C (XD1), T (XD2), or L (XD3) in the stock lists [21:vii].

Lead Time--generally refers to the amount of time required between placing an item on contract and the delivery of the item to the customer [21:vii].

Letter of Request--a letter, message or diplomatic note requesting materiel or services through FMS [21:vii].

Military Standard Requisitioning and Issue Procedures (MILSTRIP)--uniform procedures established by DOD for use within the DOD to govern requisitioning and issue of materiel within standardized priorities [21:vii].

Non-recurring Demand--demands placed on the supply system to establish or augment but not to replenish stock levels in the customer's country [21:vii].

Non-programmed Demand--demand (requisitions) for an item for which no stock level forecast exists. As such, on-hand depot assets will not normally be used to supply the requisition. Non-programmed demands will be backordered lead-time away unless the asset position is above the computed control level [21:viii].

Nonstandard Item--a defense article which is neither managed nor used by DOD [21:viii].

On-hand Stock Level--quantity of an item of supply required to be physically available in the supply system to meet anticipated demands [21:viii].

On-order Stock Level--quantity of an item of supply required to be continuously on contract to replenish the on-hand stock level [21:viii].

Ordering Period--the validity period specified on the DD Form 1513 for which the purchaser may place orders, normally 12 months [21:viii].

Programmed Demand--demand (requisition) for an item for which a stock level forecast has been incorporated into the applicable requirements computation for a sufficient period of time that depot stocks have been increased in anticipation of the demand. Programmed demands are given access to on-hand depot stocks [21:viii].

Recurring Demand--demands placed on the supply system to replenish and maintain previously established stock levels [21:viii].

Renegotiation--periodic review and update of FMSO I requirements based upon past demands and anticipated needs [21:viii].

Spare--an individual part, sub-assembly or assembly supplied for the maintenance or repair of systems or equipment [21:ix].

Storage Charges--charges for warehousing, care and preservation of materiel on hand in U.S. inventories for a participating country [21:ix].

Time Compliance Technical Order (TCTO)--that state in which, in accordance with a USAF technical order or other military department order, an otherwise

serviceable article must be processed by a maintenance activity for inspection, calibration, test, modification, or change.

Termination--cancellation of the CLSSA program in its entirety or the elimination of one or more weapons or other major systems from the CLSSA [21:ix].

Uniform Materiel Movement and Issue Priority System (UMMIPS)--standard system used within DOD to assign priorities for the issuance and movement of materiel [21:ix].

Urgency of Need Designator--a term expressed by a capital letter (A through D) which establishes the pressure of necessity for the acquisition of a resource. Used in conjunction with the assigned Force/Activity Designator to establish a positive resource demand based on mission importance and the pressure of necessity [21:ix].

Plan of Presentation

Our thesis has been organized using five chapters. Chapter I, Introduction, began with a discussion of general aspects of the Security Assistance Program. The discussion was presented in order to give the reader basic historical and factual information needed to place the remaining chapters in perspective. The problem statement was then presented and identified the research problem of determining if programmed requisitions are more quickly filled than comparable nonprogrammed requisitions. Having identified the research problem, the Purpose of the Study section defined four specific purposes for conducting our research. A Review of Related Research revealed that previous studies of the CLSSA program indicated no difference between the

fill time of programmed and nonprogrammed requisitions. The justification of our research was based upon the need for statistical verification of the claim of faster response for programmed requisitions. Also, our evaluation techniques could be used to monitor the effectiveness of the CLSSA program. The Scope and Limitations section of Chapter I indicated the basic assumptions and limitations of our research effort. Our Research Objectives and Hypotheses section explicitly stated and identified the five questions to be answered by our research. Chapter I also contained a glossary of terms used in our thesis. Lastly, Chapter I included a general discussion of the structure used throughout the thesis.

Chapter II, the Cooperative Logistics Supply Support Arrangement, presents a detailed description of the CLSSA program. Chapter II contains all information on CLSSA believed pertinent to the thesis and includes the latest changes in CLSSA policy and procedures resulting from the recently completed AFLC ILC Regulation 400-50, Cooperative Logistics Supply Support Arrangement (CLSSA). Chapter II focuses on the purpose, participation, requirements and constituent elements of CLSSA including Foreign Military Sales Orders (FMSOs) I and II. Other significant parts of Chapter II include the Requisition Processing Flow and Considerations with emphasis on programmed-nonprogrammed determination, priority designators and NMCS indicators.

Lastly, Chapter II includes a discussion on the purported advantages of CLSSA.

Chapter III, Research Methodology, describes the research methods used including assumptions and statistical analysis techniques. Chapter III describes the various data bases which contain FMS requisition information; details the requisition selection criteria and data extraction procedures of our research; defines the variables that were considered, formulates the hypotheses to be tested; and discusses the specific statistical tests to be conducted.

Chapter IV, Results and Analysis, contains an interpretation of research data generated. Chapter IV details the results of executing the requisition extraction programs and performing the statistical tests on those requisitions which met the research design criteria.

Chapter V, Conclusions and Recommendations, serves to answer the questions raised in our basic research objectives. Chapter V also contains comments on a number of conclusions as well as recommendations regarding areas of further research relative to the CLSSA program.

CHAPTER II

COOPERATIVE LOGISTICS SUPPLY SUPPORT ARRANGEMENT

The purpose of this chapter is to provide an explanation of the supply aspects of the CLSSA program. Advantages associated with participating in the CLSSA program are also enumerated. As previously discussed, the scope of this chapter is limited to the USAF CLSSA program and service code "A" items.

The primary reference source for this chapter is the recent AFLC-ILC regulation 400-50 entitled Cooperative Logistics Supply Support Arrangements. This regulation establishes CLSSA policy and procedures for ILC management of the CLSSA program for the USAF and provides the guidance necessary to establish, modify, and renegotiate a CLSSA.

Participation

Initial requests to participate in a CLSSA agreement are submitted by FMS customer countries to the Defense Security Assistance Agency (DSAA). The request must specify the mission designator series of the aircraft and the type designation of the major items which the country wishes to have supported through the CLSSA. After DSAA approval, the country is authorized to work directly with AFLC ILC to

develop the FMS cases required to implement the agreement (21:x).

Foreign Military Sales Orders

The CLSSA program consists of two cases: the Stock Level Case (Foreign Military Sales Order, FMSO I) and the Requisition Case (Foreign Military Order, FMSO II). These cases are separate but related. They are separate in that a Letter of Offer and Acceptance (LOA) is prepared for each case. They are related in that preferential supply support will be provided only to those FMSO II requisitions that have predefined requirements which have been registered on the FMSO I (16:12-13). Both cases must be executed in order for FMS requirements to be anticipated and to be satisfied on an equal footing with USAF requirements (28:18).

FMSO I

The stock level case (FMSO I) defines the customer country's requirements for 17 months of follow-on spares support to be continuously maintained on-hand or on-order for the customer. Eligible items for placement on a FMSO I are separated into three management categories: (1) USAF-managed recoverable spares--Service Code "A"; (2) USAF-managed consumable spares--Service Code "B"; and (3) Defense Logistics Agency (DLA)-managed consumable spares--Service Code "C". Under normal conditions only spare and repair

parts stocked by the USAF and DLA will be included in the stock level case (FMSO I) (16:25-26). Though the USAF has fiscal responsibility extending to the total value of the FMSO I, only the first two categories are directly related to the USAF logistics system (12:15).

The requirements projection for 17 months of follow-on spares support for the initial establishment of a FMSO I is usually accomplished by a USAF System Manager (SM). The SM requires the country's operational and maintenance data in order to formulate his recommendations. The SM has a number of sources of historical demand data to draw from in compiling a Supply Support Arrangement Renegotiation List which is forwarded to the ILC. The ILC runs this list through a HO51 edit program to insure item eligibility and to categorize the items by service code. Following the HO51 check for eligibility, the corrected list is forwarded to the customer country for review and adjustment (16:26-28). The country can adjust the recommendations associated only with the service code "A" items by adding items, deleting items, or changing the recommended quantity.

As changes occur to a country's inventory, operational program, or supply or maintenance philosophy, changes in spares usage develop which should be reflected in changes to the FMSO I requirements. To accommodate these changes, a renegotiation of the FMSO I is required. This

renegotiation can be requested by the CLSSA country, but it is normally initiated by the ILC case manager. Each FMSO I should be renegotiated every six months (21:1-12).

The International Logistics Management Information System (HO51) mechanically recomputes a renegotiation list based on the country's past FMSO II demand data. This renegotiation list then serves as the basis for the revised FMSO I.

The investment required by the FMS customer to participate in a CLSSA is based on the dollar value of the FMSO I. The funding by a country of a FMSO I case is subdivided into two categories based on the breakout of the 17 months of follow-on support between: (1) an "on-hand" segment, and (2) an "on-order" segment. Five months of the 17 months of spares is considered to be "on-hand" and requires a cash payment. Also, a one-time nonrefundable administrative surcharge of 5 percent is charged to this "on-hand" segment. Twelve months of the 17 months of spares is considered to be "on-order." Payment for this segment is not normally collected. However, the country is financially liable for the "on-order" material in the event that the stock level case is terminated or reduced at the country's request and the material cannot be absorbed back into the USAF inventory (21:1-16).

FMSO II

The requisition case (FMSO II) is established on an annual basis to permit the country to requisition spares and repair parts from the USAF inventory as in-country stocks require replenishment. This case is definitized only in terms of a dollar value and does not define either items or quantities (21:2-1).

The funding of a FMSO II case includes the estimated total material cost, appropriate transportation charges along with the following additional charges:

1. Packing, crating, and handling stock issues charge (currently 1 to 2 percent).

2. Asset use charge (currently 1 percent).

3. Administrative charge (currently 3 percent).

4. Storage costs (currently 1.5 percent of the on-hand portion of the FMSO I case) (21:2-10).

The next sections of this chapter discuss the FMSO II requisition processing flow and details how supply actions against the FMSO II requisitions (fills from stock, back-orders, etc.) are determined in the USAF supply system.

Requisition Processing Flow

Country-submitted requisitions against the FMSO II case are received by the HO51 system which determines which Air Logistics Center (ALC) has management responsibility for the item. The requisition is then transmitted to the

responsible ALC for processing by the Stock Control and Distribution System (DO32). The DO32 system maintains a record of the asset balances for all inventory items for which the ALC is responsible.

Requisition Processing Considerations

The priority accorded FMSO II requisitions for service code "A" items relative to other FMS and USAF requisitions depends upon a number of factors. The principal factors are: programmed versus nonprogrammed, quantity requisitioned versus available assets, priority code, and the Not Mission Capable-Supply (NMCS) indicator. The subsequent paragraphs will define the values that these factors can have and what the decision rules are for queueing and filling requisitions based on the various values.

Programmed-Nonprogrammed Determination

The HO51 system screens all of the country submitted requisitions to determine whether the requisition will be treated as programmed or nonprogrammed. The requisition is coded as programmed when: (1) the item being requisitioned had appeared on the FMSO I case for one year or more; (2) it has a recurring demand code; and (3) the quantity being requisitioned is equal to or less than the Eligible-to-be-Programmed Quantity (EPQ) (21:2-4).

Priority Designator

The priority designator entry on FMS requisitions is based upon a combination of factors which signify the mission of the requesting country (force-activity designator (FAD)) and the urgency of need or end use (urgency of need designator (UND)). The FADs for FMS countries are assigned by the Joint Chiefs of Staff. The UND for the requisition is determined by the requisitioning country. The criteria for the various UND codes are:

"A"--immediate end use and without which the force-activity is unable to perform assigned operational missions.

"B"--immediate end-use and without which the capability of the force-activity to perform assigned operational missions is impaired.

"C"--or schedule repair-maintenance-manufacture or replacement of all equipment (24:Vol. 1, Part 1:24-3 to 24-8).

Not Mission Capable-Supply (NMCS) Indicator

The requisitioning country can place the following values in the NMCS field of the requisition:

"N"--designates that the requisition is a priority request for an item which is causing a weapon system to be in a not mission capable condition.

"E"--designates that the requisition is also a priority request for an item without which a weapon system is "anticipated" to be in a not mission capable condition.

The queueing discipline of FMS requisitions in the Stock Control and Distribution System (DO32) consists of an initial partitioning of the requisitions into two groupings based upon the priority code. The first grouping consists of those requisitions having a priority code of 1 through 8; the second grouping contains the priority 9 through 15 requisitions. Within these two groupings, requisitions are ordered according to the different values in the NMCS field with the following precedence: "N" followed by "E" followed by those requisitions with a blank NMCS indicator.

It is important to understand that though the FMS requisitions are ordered by the queue discipline described above, they are not necessarily filled in that order against available stocks. There are two stock levels which are important in determining whether or not a requisition is filled from on-hand assets or is placed on backorder: the control level and the support level.

The control level for an item is based on the average two-year plus lead time demand rate for the item. For example, if the historical demand for an item had been 1 per month and the item had a lead time of 14 months, its control level would be 38 (24 + 14). The support level for an item is based on an average 30-day demand level.

Thus, for the same example item, the applicable support level would be 1.

The asset release criteria defined in terms of the requisition's priority, the NMCS indicator, and the programmed-nonprogrammed indicator are summarized in Table 2-1.

TABLE 2-1

ASSET RELEASE CRITERIA

Priority	NMCS	CLSSA	Asset Release Criteria
1 thru 8	N or E	Programmed	Ship to zero balance
1 thru 8	N or E	Non-programmed	Ship only if control level will not be breached
1 thru 8	Blank	Programmed	Ship to zero balance
1 thru 8	Blank	Non-programmed	Ship only if control level will not be breached
9 thru 15	Not applicable	Programmed	Ship only if support level will not be breached
9 thru 15	Not applicable	Non-programmed	Ship only if control level will not be breached

If the DO32 system determines that shipments cannot be made from stocks because of low priorities or insufficient on-hand inventory, the Item Manager (IM) is notified by means of a backorder listing and must do one of two things. He must either initiate new procurement for the

item or send amended shipping instructions to the contractor. Amended Shipping Instructions (ASI) are applicable when a procurement request is still out on contract. The IM can contact the contractor and request that a specific quantity be shipped directly from the contractor's facility (12:49). Backordered requisitions can be filled earlier than the production lead time when and if the item's asset position rises above the control level (for nonprogrammed backorders) or the support level (for programmed backorders).

Thus the mechanics of the preferential supply support for those countries participating in the CLSSA program can clearly be seen. By forecasting requirements and funding the FMSO I equity in the USAF supply system, the CLSSA country is given controlled access to on-hand USAF depot stocks.

Other Advantages of CLSSA

Along with the preferential supply support, there are a number of additional advantages associated with CLSSA participation. These additional advantages are detailed below.

1. CLSSA participating countries benefit from the reduction of in-country stock levels. By participating in CLSSA, member countries have access to the five-month stock level maintained in the USAF logistics system. In

addition, a twelve-month level of supply is on order at all times. CLSSA-identified items are stored with USAF items and both receive the same storage and quality control standards. Also, AFLC assists member countries in determining recommended stock levels based upon historical data (9:3).

2. The CLSSA program is viewed as furnishing participating countries equipment at reduced rates through the advantage of combined (volume) purchases.

3. The stock level of CLSSA participating countries is routinely reviewed and revised after the development of sufficient demand history. The revision is accomplished at least annually to assure proper stockage levels of items considered essential (28:F-3).

4. The participating country benefits from the latest item modifications and configurations. The CLSSA customer is routinely advised of selected catalog changes including advice on deleted items. The CLSSA also provides for modification of the customer's stock held by the USAF resulting from engineering changes thus further reducing the possibility of using obsolete stocks (9:3).

CHAPTER III

RESEARCH METHODOLOGY

The purposes of this chapter are to: (1) describe the various data bases which contain FMS requisition information; (2) detail the requisition selection criteria and the data extraction procedures of our research; (3) define the variables that were considered; (4) formulate the hypotheses to be tested; and (5) discuss the specific statistical tests conducted.

Population and Sample Description

All USAF FMS follow-on support requisition data is received by and maintained in the International Logistics Management Information System (HO51). The initial country-submitted requisitions along with all associated supply status and shipping status transactions are maintained in the HO51 computer data files.

The HO51 requisition computer files are segmented in the following manner: (1) the requisition master file (HO51.LDRO) contains summary supply data on all open (i.e., not delivered) requisitions; (2) the inactive history file (HO51.LTBO) contains minimum requisition summary data for requisitions which were delivered more than 120 days past; and (3) the active history file (HO51.LTAO) contains

detailed status transactions for all requisitions which are not on the inactive history file. These three files are all in country, case sequence (30).

To accomplish our analysis, the LDRO file was selected. The principal reason for using the LDRO file is that the prohibitive size (approximately 100 reels of computer tape) of the LTAO or the LTBO file negates economical computer processing. The LDRO file permits an efficient experimental design in that requisitions from all FMS countries will be considered while computer processing costs will be nominal.

Data Collection Plan

Though the HO51 system offers a number of data extraction options, none of them is sufficient to satisfy our data requirement needs. In order to collect our sample of requisitions, the following steps were taken:

1. The LDRO tape file was converted from its present IBM 7080 format to CREATE-compatible format for processing on the CREATE computer system.

2. The LDRO file was then sorted (with only those requisitions against type "A" items being selected) into NSN, HO51 receipt date sequence.

3. A program was written and executed to identify those NSNs which had both programmed and nonprogrammed

requisitions against them and to build a data base of the requisitions against these NSNs.

Figure 3-1 illustrates the principal steps involved in extracting the sample information required for our data analysis. The computer programs and control cards that were developed to extract the data from the LDRO tape and build the data base are included in Appendix A.

The size of our data base was determined by the number of requisitions that meet the conditions stated in step 3 above. It was assumed that the number of requisitions meeting the criteria of the research design would be sufficient for statistical testing purposes. The required sample size for statistical testing purposes was determined using the following equation (4:151):

$$\sigma_p = \sqrt{\frac{pq}{n-1}}$$

where:

±0.10 = the desired interval range within which the population proportion is expected (subjective decision).

1.96 = .95 confidence level for estimating the interval within which to expect the population proportion (subjective decision).

0.051 = standard error of the proportion (0.10, 1.96).

p = percent of population in the programmed category

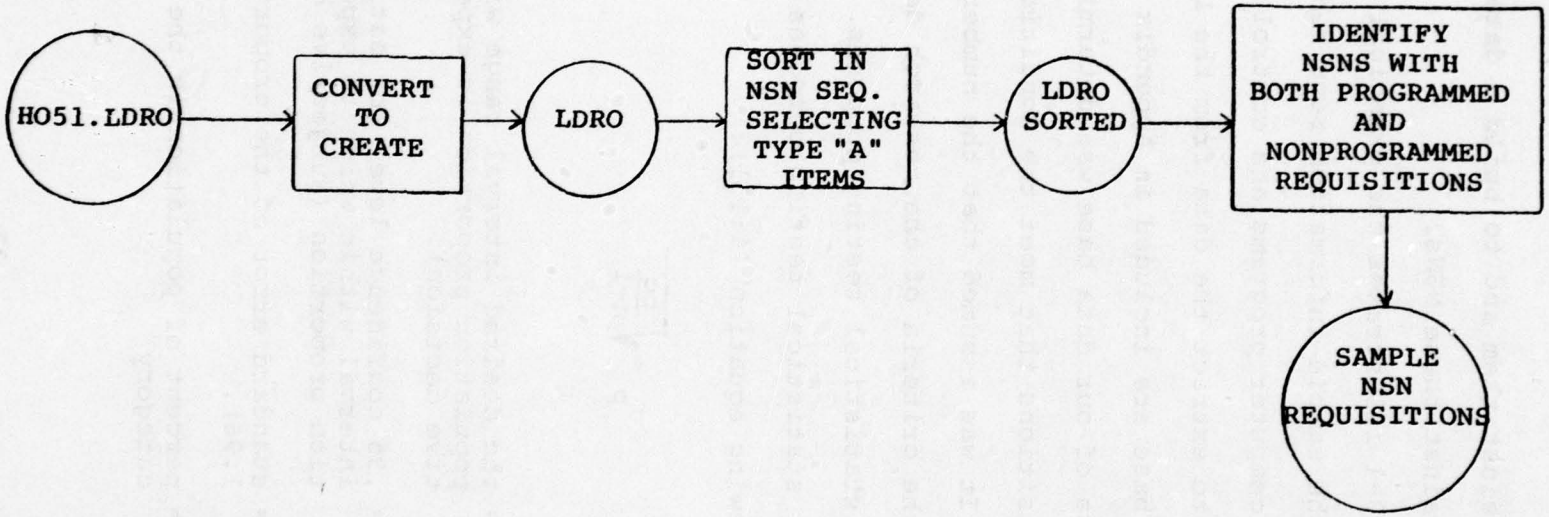


Fig. 3-1. Data Sample Extraction Steps

q = percent of population in the nonprogrammed category.

pq = measure of sample dispersion (used here as an estimate of population dispersion). pq=0.5x0.5 =0.25 which is the maximum variance estimate since no value of p or q is available. The value of pq can never exceed 0.25. If either p or q is greater than 0.5 then their product is smaller than 0.25 (e.g., 0.4x0.6=0.24, etc.). When we have no information on the probable p value we can assume that p=0.5 and solve for the sample size (4:151).

n = sample size.

In solving for n using the maximum variance estimate the required sample size was 97.12.

Because our sampling plan is quite selective and therefore delimiting in terms of the total population of FMS recoverable requisitions, no population correction factor was necessary (4:150).

A priori, we had no reason to believe that the requisition submittal process and the processing and supply activities have cyclic fluctuations. By cyclic fluctuations, we mean that the processes involved have some form of dependence on time (21:603). We took two samples, three months apart, to ensure that our results would be consistent irrespective of the time of the year the analysis was performed.

Variables

There were five specific variables that the program used to build the data base extracted from the LDRO tape.

The variables that were processed to the data base include the following:

1. QTY--the quantity of the item that the country requisitioned. This variable was extracted from columns 25-29 of the LDRO tape.

2. NMCS--the Not Mission Capable-Supply indicator that the country specified on the requisition. A value of a "N" or an "E" in column 63 of the LDRO tape signifies a NMCS requisition and was recoded as a "1" for the data base. All other values in column 63 were coded as a "2".

3. PRI--the priority code that the country specified on the requisition. This variable was extracted from columns 61-62 of the LDRO tape.

4. PRGM--the programmed-nonprogrammed indicator of the requisition as determined by the HO51 system. A value of "6" in column 140 of the LDRO tape signifies a programmed requisition and was recoded as a "1" for the data base. All other values in column 140 were recoded as a "2".

5. FILLTIME--the computed fill time of the requisition. For those requisitions which had a shipping status data, the fill time was computed as follows:

FILL TIME = SHIP DATE - HO51 DATE OF RECEIPT

The HO51 date of receipt is the date that the requisition was received by the HO51 system. For those requisitions

with only a supply date and not a ship date, the fill time was computed as follows:

FILL TIME = SUPPLY DATE - HO51 DATE OF RECEIPT + 10

A supply date is the date when the Item Manager has identified the asset(s) that will be used to fill the requisition. The addition of 10 days was based on the average difference between the ship date and the supply date. This difference was found by averaging the differences that were found on those requisitions which had both a ship date and a supply date. For those requisitions which had a partial shipment and a partial supply status, the fill time was computed as a weighted average. The weighted average was based on the ratio of the quantity shipped and the quantity in a supply status to the quantity requisitioned.

Research Design to Test Fill Time Hypotheses

The statistical test conducted to test the contention that programmed requisitions receive faster support, in terms of fill days, than similar nonprogrammed requisitions (objectives II) is a T-test. The objective of the T-test is to determine whether or not the difference between the sample of fill times for programmed requisitions and the sample of fill times for nonprogrammed requisitions implies a true difference in the parent population's

means (8:267). In other words, "Are the mean fill times really different?"

We had reason to propose, in advance of the analysis, not only a difference in the fill times but also the direction of that difference. Thus, the research hypotheses were directional, and a one-tail statistical test was required (3:167).

The alternative hypothesis is that the mean fill time for programmed requisitions is statistically less than the mean fill time for nonprogrammed requisitions.

$$H_1: \ U_p < U_n$$

The associated null hypothesis is that there is no discernible difference between the fill times of programmed and nonprogrammed requisitions.

$$H_0: \ U_p \geq U_n$$

Because sampling is used, a decision to accept or reject H_0 cannot be made with absolute certainty; the decision must be made in terms of probabilities (14:268). Our decision rule for conducting test was based on a significance level of 5 percent.

Rejection of H_0 involved comparing the computed prob value produced by the Statistical Package for the Social Science (SPSS) T-test directive to the significance level of 5 percent. The computed prob value for the

appropriate one-tail test was obtained by dividing the SPSS produced two-tail probability by two. The decision rule for rejecting the null hypothesis is twofold: (1) if the one-tailed probability is smaller than the significance level, and (2) the sign of the t value is as expected (14:269).

There are four assumptions associated with a test of differences between two population means:

1. Both samples must be selected randomly from their respective populations.

2. The observations must be independent, both within each sample and between the two samples.

3. The populations from which the samples were selected must be normally distributed.

4. The population from which the samples were selected must have equal variances (3:173).

Our data collection plan could be considered a sample of convenience as opposed to a random sample. The fact that all requisitions which met our selection criteria were processed to our data base for analysis negates any sampling bias favoring one segment of the population over another segment. The observations (requisitions), as described in our data collection plan, were not independent. Only programmed requisitions against NSNs which also had nonprogrammed requisitions activity were selected. This dependency of observations was necessary to meet the

research objective of comparing requisitions for like items in order to properly access the CLSSA program.

The normality assumption was evaluated with a Kolmogorov-Smirnov goodness-of-fit test. The homogeneity of variance assumption was tested with an F test of the sample variances. The hypotheses tested were: $H_0: \sigma_1^2 = \sigma_2^2$ against $H_1: \sigma_1^2 \neq \sigma_2^2$ with a significance level of .05. The results of this test also determined whether the SPSS computed t statistic should be based on the pooled variance estimate (when H_0 is accepted) or based on the separate variance estimate (when H_0 is rejected) (14:270).

Research Design to Test NMCS Fill Time Hypotheses

The research design to test the contention that programmed NMCS requisitions receive better support than similar nonprogrammed NMCS requisitions (objective 3) was essentially the same as the research design discussed above with one addition. That addition was that the sample included only those requisitions which met the previous requisition selection criteria and which also had a "N" or an "E" in the NMCS field of the requisition. The hypotheses tested were:

$$H_0: \ U_{pn} \geq U_{nn}$$

$$H_1: \ U_{pn} < U_{nn}$$

where:

U_{pn} = average fill time for programmed NMCS requisitions, and

U_{nn} = average fill time for nonprogrammed NMCS requisitions.

Research Design to Test the Assumptions Regarding Other Independent Variables

As detailed in Chapter II, the programmed-nonprogrammed indicator is not the only variable which can influence the fill time of a requisition. It is important in our research design that these other indepedent variables be randomly distributed across both the programmed and nonprogrammed requisition samples. For example, if the issue priorities in the nonprogrammed requisition sample differ significantly from the issue priorities in the programmed requisition sample, any analysis of the fill times of the two samples requires consideration of this difference.

A series of T-tests were conducted on those independent variables which can influence the fill time. The specific hypotheses tested are summarized below:

1. Issue Priority

$$H_0: \quad U_{pp} = U_{np}$$

$$H_1: \quad U_{pp} \neq U_{np}$$

where:

U_{pp} = average priority on the programmed requisitions, and

U_{np} = average priority on the nonprogrammed requisitions.

2. Requisition Quantity

$$H_0: \ U_{pq} = U_{nq}$$

$$H_1: \ U_{pq} \neq U_{nq}$$

where:

U_{pq} = average quantity on the programmed requisitions, and

U_{nq} = average quantity on the nonprogrammed requisitions.

3. Not Mission Capable Supply (NMCS)

$$H_0: \ U_{pnmcs} = U_{nnmcs}$$

$$H_1: \ U_{pnmcs} \neq U_{nnmcs}$$

where:

U_{pnmcs} = average occurrence of the NMCS indicator on the programmed requisitions, and

U_{nnmcs} = average occurrence of the NMCS indicator on the nonprogrammed requisitions.

The objective of these T-tests was to determine if the difference observed between the programmed and nonprogrammed fill times was not influenced by extraneous variables such as the NMCS indicator, issue priority, and

quantity. If the above tests of equal means cannot be accepted, the fill time hypotheses may be biased and inaccurate.

Research Design to Investigate Why Programmed Support is Not Better

The T-test provided information regarding the statistical difference of the programmed and nonprogrammed mean fill times, but of further concern is the magnitude of the difference (Objective 4). A priori, we estimated that the difference between the fill times of the two types of requisitions should be approximately 330 days. This criterion test of 330 days is based on the premise that, in most cases, programmed requisitions will be filled directly from stock (fill time equal to approximately 30 days) and nonprogrammed requisitions will be filled lead time away (fill time equal to approximately 360 days). If the difference between the mean fill times does not compare with the criterion test of 330 days, then an investigation as to why the programmed support is not better is required.

The research design to determine why AFLC's logistics system is failing to provide a better level of support for programmed requisitions (objective 5) involved a detailed examination of some specific NSNs that had not experienced fill times for programmed and nonprogrammed requisitions that one would expect. NSNs were selected

for detailed examination that had been supported in one of the following manners:

1. Nonprogrammed requisitions being filled faster than comparable programmed requisitions;

2. Programmed requisitions being filled in greater than 300 days; or

3. Nonprogrammed requisitions being filled in less than 90 days.

The detailed examination of those NSNs, found to be supported as defined above, was accomplished by: (1) reviewing all recent FMS requisition activity against them; (2) identifying the supply and requirements factors (e.g., the FMSO I level, serviceable assets, lead time, applicable weapon system(s) of those NSNs; and (3) questioning the responsible Item Manager (IM) regarding the timeliness of the fill times for specific requisitions. To obtain a printout of all recent FMS requisitions applicable to a NSN, a RO62 NSN interrogation of the HO51.LDAO data base was executed. To obtain the supply and requirements factors, a NSN interrogation using the Variable Safety Level (VSL) Model was performed.

The questioning of the IMs was conducted by telephone and was both structured and unstructured. Questions were posed to determine if the IM understands: (1) the differences between programmed and nonprogrammed requisitions; and (2) the control and support stock level concepts.

Then, questions concerning why the fill times for some specific requisitions are contrary to what one would expect were pursued with the IM. Finally, the results of this investigation were summarized with the objective of finding common reasons as to why the programmed support was not better.

Summary List of Assumptions

1. Our research design will generate sample sizes sufficient for statistical testing purposes.

2. There are no cyclic fluctuations associated with the requisition and supply processes.

3. Other independent variables such as quantity, issue priority, and NMCS indicator are independent of the programmed and nonprogrammed dichotomy and will not affect the hypotheses testing.

Summary List of Limitations

The research design will permit us to make inferences concerning the CLSSA program in general but will not allow us to make inferences regarding the supply support a specific country or a specific weapon system would receive under CLSSA.

Summary

In this chapter we have outlined the steps necessary to analyze the supply effectiveness of programmed

requisitions. In particular, the specific research designs for each of the research objectives were explained. In the next chapter, the results of conducting the analysis are provided.

CHAPTER IV

RESULTS AND ANALYSIS

This chapter details the results of executing the requisition extraction programs, building the requisition data base, and performing the statistical tests on those requisitions which met the research design criteria. The results of our investigation as to why support for programmed requisitions is not better is also discussed.

Results--Data Collection

The steps previously illustrated in Figure 3-1 were executed against the HO51.LDRO tapes dated 28 March 1979 and 28 June 1979. Table 4-1 summarizes the results of the FMS requisition extraction logic that was performed.

As shown in our sampling plan in Chapter III, the required sample size for statistical testing purposes was found to be 100. As the results of the data collection indicate, a sufficient number of requisitions met the research design selection criteria.

Descriptive Statistics

Descriptive statistics are used to simplify and summarize data so that the information content of the data can be more easily comprehended (5:110). Using the

TABLE 4-1

RESULTS OF FMS REQUISITION EXTRACTION

	March Tape	June Tape
Number of Requisitions	478,304	300,441
Number of Requisitions - Recoverable Items	12,669	8,409
Number of Filled Requisitions - Recoverable Items	2,887	1,610
Number with Both Programmed and Nonprogrammed		
- Requisitions	479	275
- NSNs	144	88

Statistical Package for the Social Sciences (SPSS) CONDESCRIPTIVE subprogram,[1] the basic distributional characteristics of the FILL TIME variable for the two types of requisitions (programmed and nonprogrammed) were computed (14:181). Table 4-2 details the various statistics associated with the FILL TIME variable that this subprogram produced.

The values in Table 4-2 indicate a considerable difference in some of the statistics (mean, median) between the March and the June sample. These differences cannot be explained by the researchers. Identical procedures were used to generate each of the samples.

[1]Listings of all of the SPSS directives that were used in our analysis are provided in Appendix B.

TABLE 4-2

FILL TIME STATISTICS

	Programmed Requisitions		Nonprogrammed Requisitions	
	March Sample	June Sample	March Sample	June Sample
Sample Size	280	146	199	129
Range	3 to 833	6 to 1058	5 to 1041	12 to 988
Mean	160.4	269.7	234.3	371.9
Standard Deviation	255.8	251.4	251.5	284.0
Mode	12	13	13	13
Median	24.2	188.2	122.0	305.0

NOTE: All values are in days.

The SPSS FREQUENCIES subprogram was executed to group the data in order to set a better understanding of the distributions of the fill times. The cumulative frequency percentages derived from this subprogram were used to generate plots of the cumulative distributions for both programmed and nonprogrammed requisitions, and for the NMCS programmed and nonprogrammed requisitions. The Graphics Compatibility System (GCS) software package was used to generate the plots on a CALCOMP plotter (31). The plots are presented in Figure 4-1 through 4-4.

The plots illustrate that the programmed requisitions receive a better percentage fill rate, when viewed over time, than comparable nonprogrammed requisitions. This improved fill rate also holds true for the NMCS requisitions. We will now test the assumptions discussed in the research design and review the results of the T-tests to determine if the fill times for the programmed and nonprogrammed requisitions are statistically different.

Results--Assumptions

Other Independent Variables

Prior to evaluating the mean differences in the programmed and nonprogrammed fill times, the assumptions detailed in our research methodology were tested. The concern regarding the other independent variables and their influence on the fill times of the two samples was

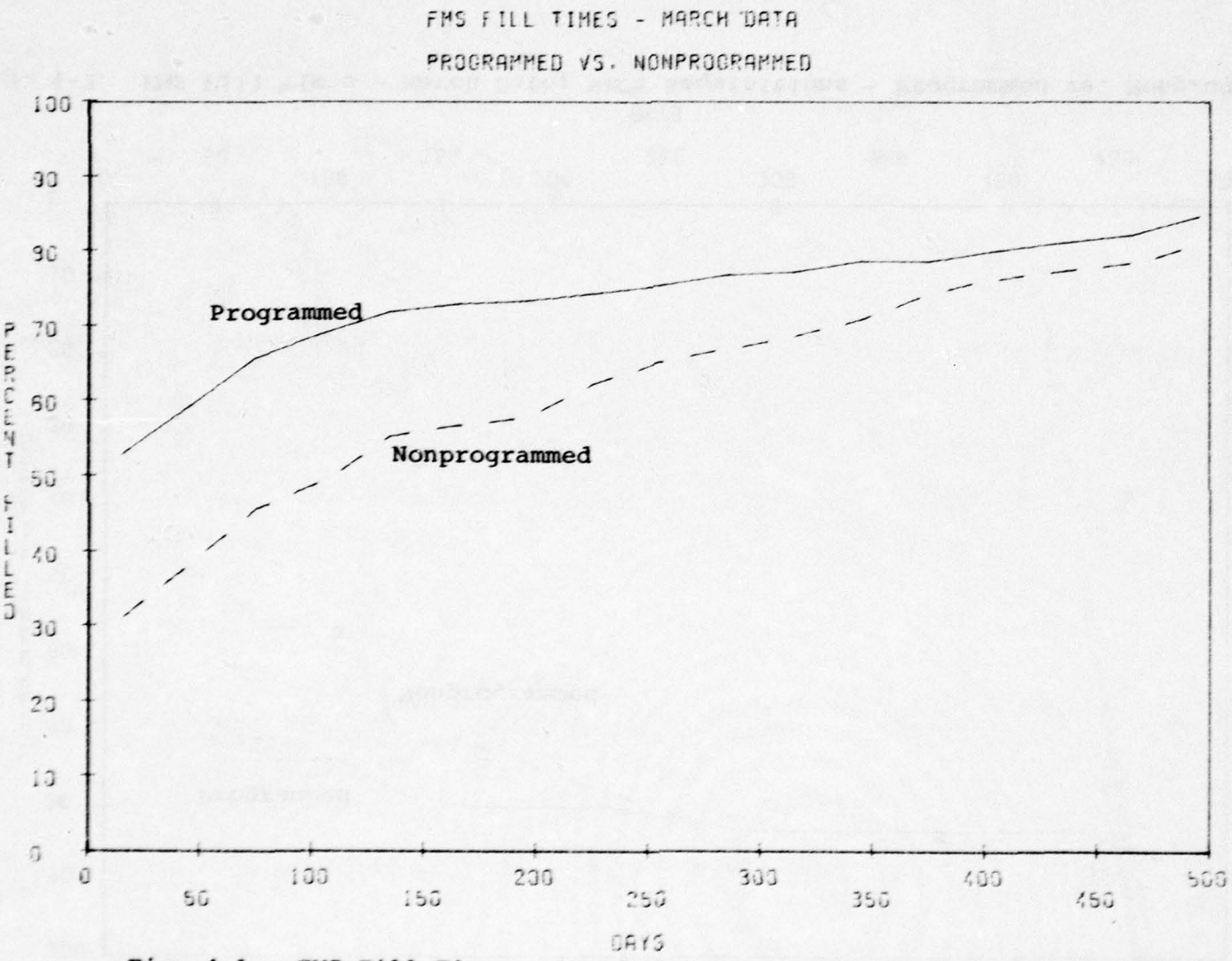


Fig. 4-1. FMS Fill Times - March Data; Programmed vs. Nonprogrammed

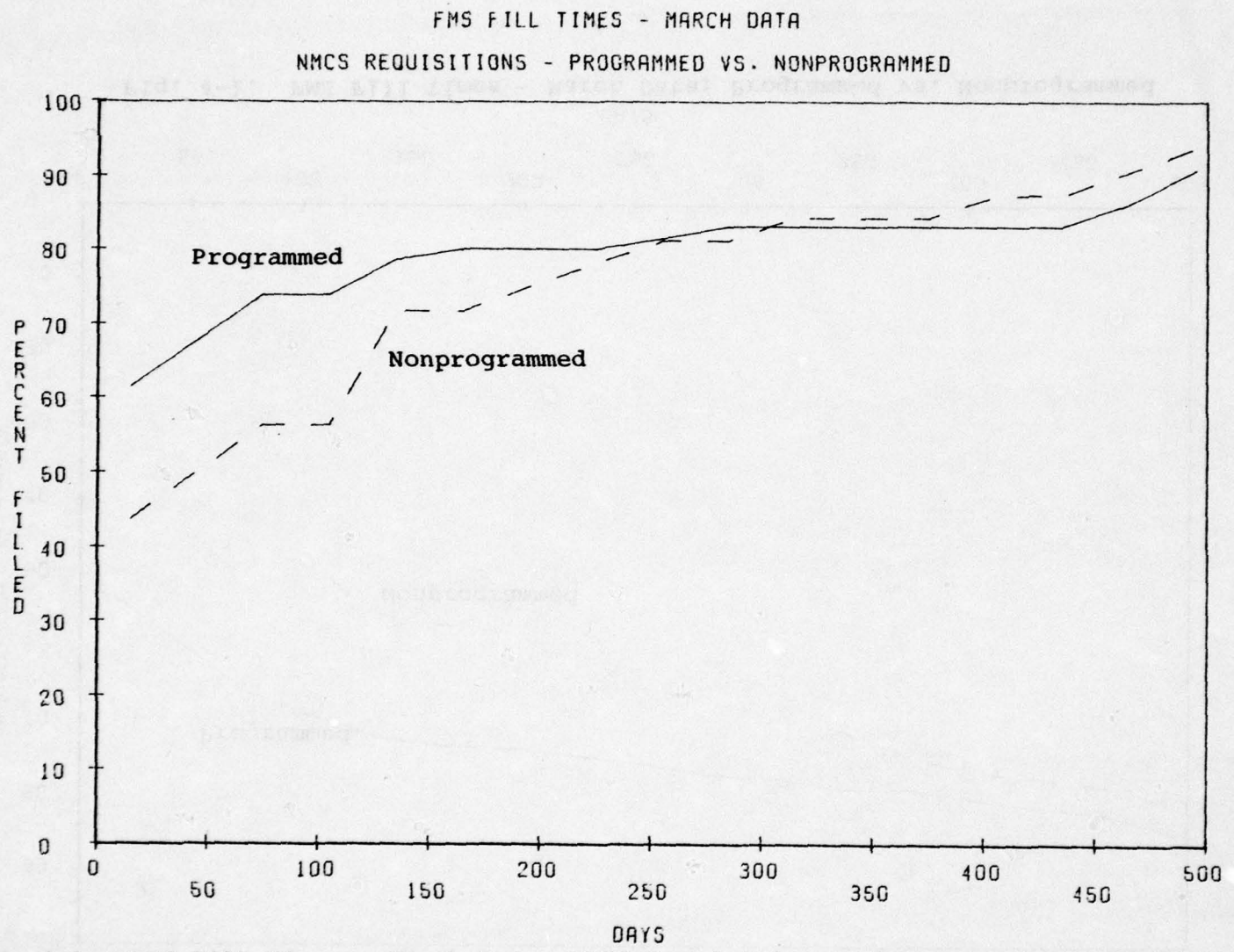


Fig. 4-2. FMS Fill Times - March Data; NMCS Requisitions - Programmed vs. Nonprogrammed

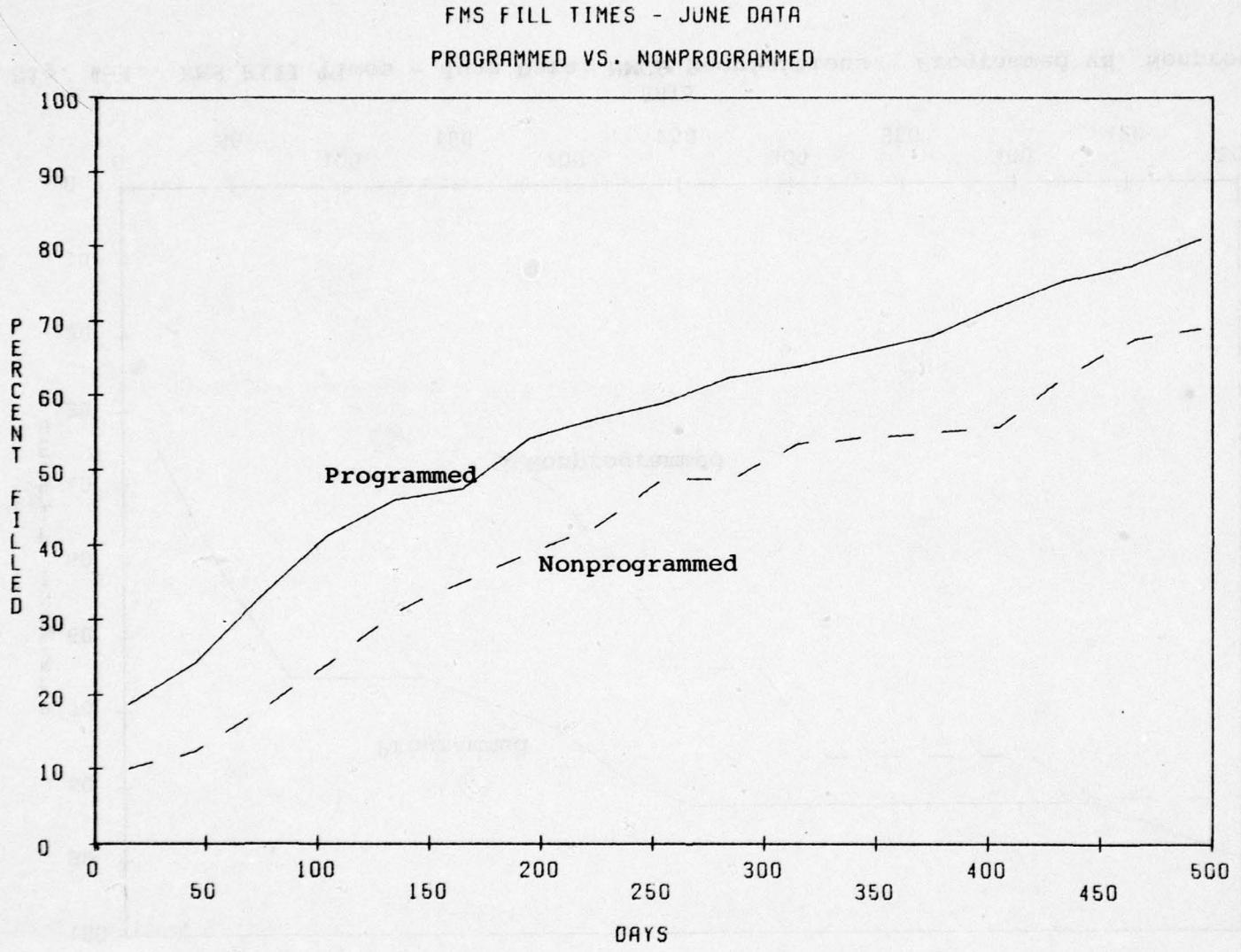


Fig. 4-3. FMS Fill Times - June Data; Programmed vs. Nonprogrammed

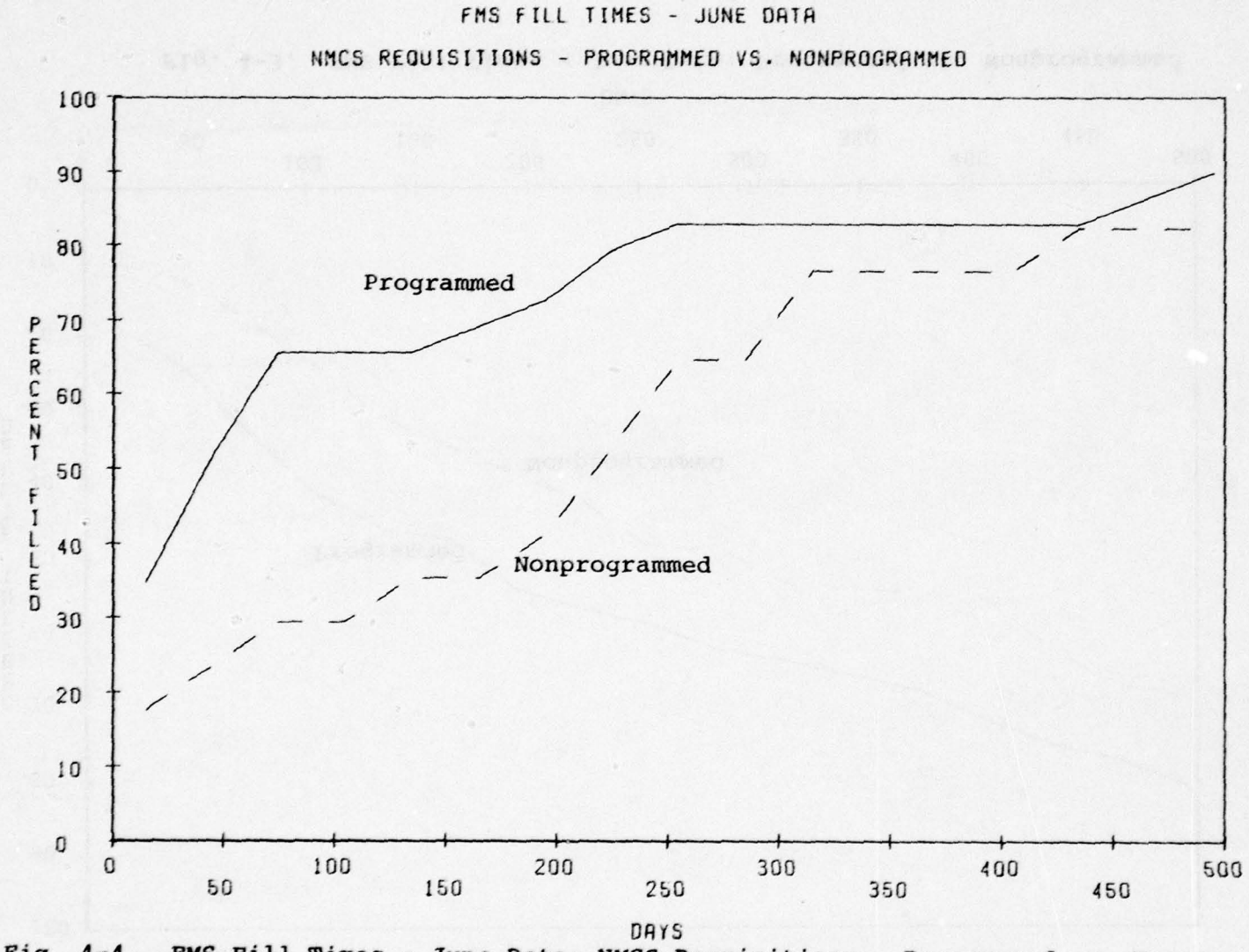


Fig. 4-4. FMS Fill Times - June Data; NMCS Requisitions - Programmed vs. Nonprogrammed

evaluated with a series of T-tests. The mean values of the other independent variables considered are provided in Table 4-3.

TABLE 4-3

MEAN VALUES OF INDEPENDENT VARIABLES

Variable	Type	March Sample	June Sample
Issue Priority	Programmed	7.9	7.7
	Nonprogrammed	8.3	7.1
NMCS Indicator	Programmed	1.77	1.8
	Nonprogrammed	1.84	1.9
Quantity	Programmed	3.6	3.4
	Nonprogrammed	6.4	5.9

The results of the T-tests indicated that, of the three other independent variables tested, the null hypothesis of equal means can be rejected only for the quantity requisitioned variable. The fact that the average quantity in the programmed sample was statistically less than in the nonprogrammed sample can be partially explained by reexamining the determination process for a requisition to be coded as programmed (as discussed in Chapter II). In order for a requisition to be coded as programmed, its quantity must be less than the FMSO I eligible-to-be-programmed

edit performed by the HO51 system. The fact that the average quantity in the programmed sample was less than the average quantity in the nonprogrammed sample can be explained by the mechanics of the programmed eligibility determination process.

The fact that the quantity in the programmed sample is less than in the nonprogrammed sample may contribute in part to a faster fill time for programmed requisitions. Thus, our analysis associated with comparing the fill times for the programmed and nonprogrammed samples must be made with a caveat for this quantity difference between the two samples.

Homogeneity of Variance

The results of the F tests conducted on the sample variances to test the homogeneity of variance assumptions are now discussed. The F statistic, used to define the rejection region for the test, is based on the sample size and the significance level. For a significance level of .05, the critical region for each of the samples, using the tables in Guenther (6:486-489), is given below:

March sample: $f_{198,279,.025} = .729$

$f_{198,299,.975} = 1.21$

June sample: $f_{145,128,.025} = .698$

$f_{145,128,.975} = 1.43$

The F test statistic for March is:

$$\frac{s_1^2}{s_2^2} = \frac{50985.64}{63252.25} = .806 ;$$

for June is:

$$\frac{s_1}{s_2} = \frac{63201.96}{80656.00} = .783 .$$

Because the test statistic for both of the samples does not fall within the rejection regions, the hypothesis of equal variances can be accepted (6:237-238). By being able to accept the homogeneity of variance assumption, we can use the pooled variance estimate for the calculations of the T-test.

Normality Assumption

A Kolmogorov-Smirnov test was run to test the assumption of normality of the populations. The fill times for each of the samples (i.e., March programmed, March nonprogrammed, June programmed, and June nonprogrammed) were tested. The Kolmogorov-Smirnov analysis is a test of the goodness of fit and is concerned with the agreement between the distribution of a set of sample values and some theoretical distribution (20:47).

The Kolmogorov-Smirnov test was conducted using the "SIMFIT" program which is maintained in the Air Force

Institute of Technology's logistics software library. The "SIMFIT" program tests the data against a theoretical normal distribution and produces histograms comparing the actual data with the theoretical distribution.

The results of the Kolmogorov-Smirnov analysis for each of the samples is provided in Table 4-4.

TABLE 4-4

KOLMOGOROV-SMIRNOV ANALYSIS TEST FOR NORMALITY

Sample	Chi square	Sum
March--programmed	19.81	967.137
March--nonprogrammed	21.06	358.977
June--programmed	21.06	109.183
June--nonprogrammed	24.77	967.137

The decision rule for accepting the data as being normally distributed requires that the sum be less than the Chi square value. As Table 4-4 above indicates, none of the samples conform to a normal distribution. The histogram and curve approximation for the March nonprogrammed sample is provided in Figure 4-5. As the histogram illustrates, the data points are skewed considerably to the right. The histograms for the other samples also exhibit this skewness. Though our sample data violates the assumption of normality, a great deal of careful research has shown that the normal population distribution assumption may be waived. The

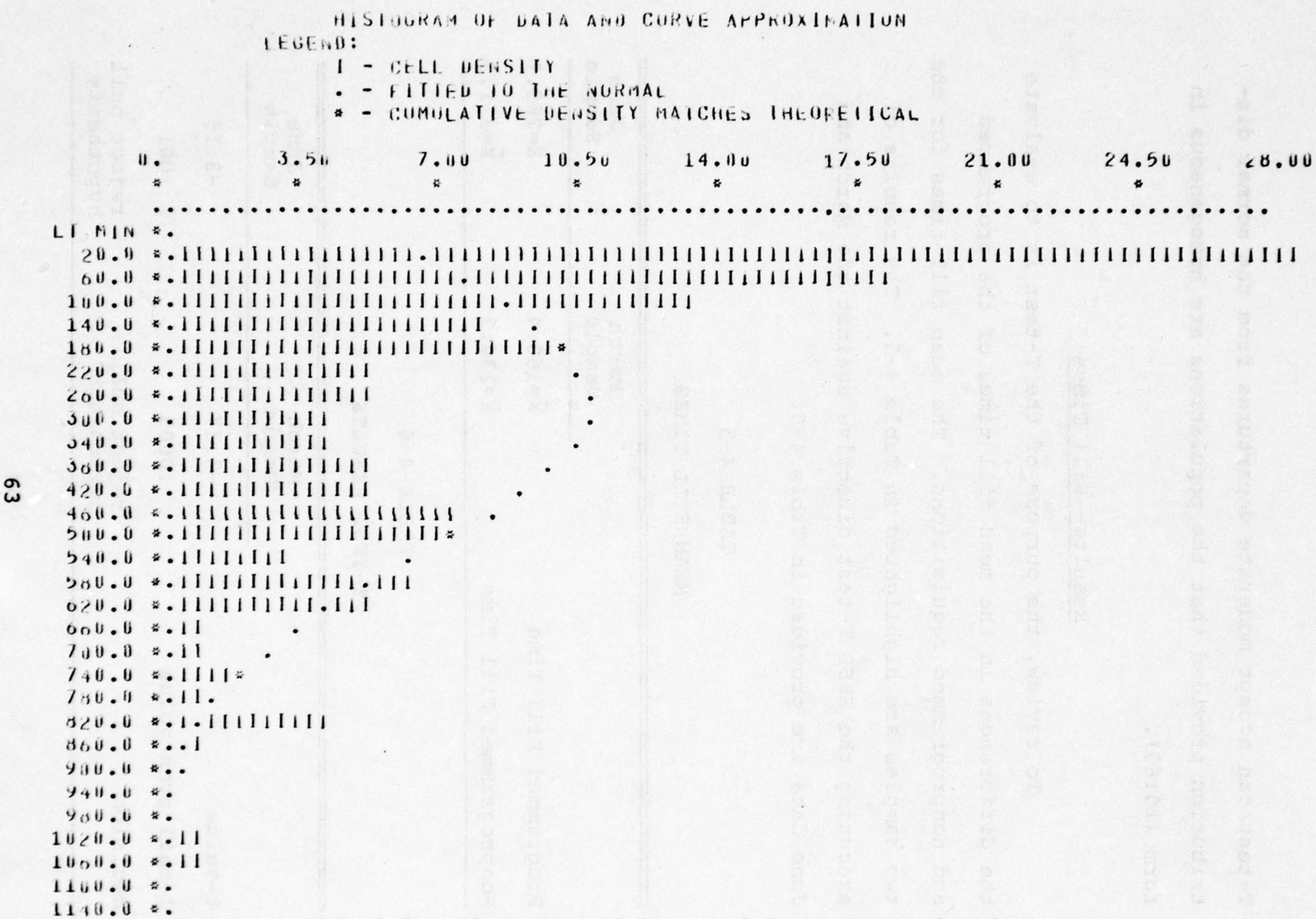


Fig. 4-5. Histogram of Data and Curve Approximation

T-test can accept moderate departures from the normal distribution provided that the populations are homogeneous in form (10:63).

Results--Fill Times

To review, the purpose of the T-test is to evaluate the differences in the mean fill times of the programmed and nonprogrammed requisitions. The mean fill times for the two samples are highlighted in Table 4-5. The results of executing the SPSS T-test directive against the March and June data are provided in Table 4-6.

TABLE 4-5

MEAN FILL TIMES

	March Sample	June Sample
Programmed Fill Time	$\bar{X}$=160.4	$\bar{X}$=269.7
Nonprogrammed Fill Time	$\bar{X}$=234.3	$\bar{X}$=371.9

TABLE 4-6

T-TEST RESULTS

	March Sample	June Sample
t-value	-3.37	-3.16
1-tail prob value	.0005	.001
decision	reject null hypothesis	reject null hypothesis

As detailed in our research methodology, the decision rule (i.e., if the one-tailed probability is less than the significance level) allows us to reject the null hypothesis that the nonprogrammed fill times are statistically equal or greater than programmed fill times for both the March and June samples. Thus, we can conclude that the mean fill times for programmed requisitions are statistically less than the fill time for comparable nonprogrammed requisitions.

Results--NMCS Fill Times

The mean fill till times for the NMCS coded requisitions are highlighted in Table 4-7. The results of executing the SPSS T-test directive for the NMCS coded requisitions for the two samples are provided in Table 4-8.

TABLE 4-7

NMCS MEAN FILL TIMES

	March Sample	June Sample
Programmed Fill Time	$\bar{X}$=126.5	$\bar{X}$=146.4
Nonprogrammed Fill Time	$\bar{X}$=156.7	$\bar{X}$=286.9

TABLE 4-8

T-TEST RESULTS

	March Sample	June Sample
t-value	-.65	-1.86
1-tail prob value	.258	.037
decision	cannot reject null hypothesis	reject null hypothesis

The T-test decision rule does not allow us to reject the null hypothesis that the nonprogrammed NMCS fill times are statistically equal to or less than the programmed NMCS fill times for the March sample. In other words, the difference between the mean fill times of 126.5 days for the programmed NMCS requisitions versus the 156.7 days for the nonprogrammed NMCS requisitions are not statistically significantly different at a .05 significance level. We can conclude from this test that a country's NMCS requisitions do not appear to benefit significantly if they are also coded as programmed.

Results--Why Programmed Support is Not Better

In an attempt to determine why support for programmed requisitions was not being provided in the manner in which our criterion test required, we conducted a number of in-depth discussions with selected IMs. As indicated in our research methodology, IMs were questioned regarding:

(1) their understanding of the differences between programmed and nonprogrammed requisitions; (2) their awareness of the control and support stock level concepts; and (3) why the fill times for some specific requisitions were contrary to what one would expect.

Based on these discussions, we developed the following general opinions. In most cases, the IMs recognized and clearly understood the concepts of programmed and nonprogrammed requisitions and their relationship with the support and control levels. Their knowledge in these areas appeared more than adequate to appropriately manage FMS requisitions. It was also clear that every IM contacted was concerned with doing a quality job with regard to filling requisitions in the correct manner.

In addition to the general opinions formed concerning the role of the IMs, we were provided considerable insight into some of the problems facing the IMs relative to providing better support for programmed requisitions. We have categorized these problems into eight areas:

1. Training
2. Conflicting guidance
3. Direct shipment procurement actions
4. Excessive NMCS requisitions
5. Other variables on the requisition
6. IM misconceptions

7. Erroneous shipment notifications

8. Weapon system modifications

Each of these problem areas will now be discussed in detail.

Training

In the area of formal training, it was encouraging that a number of the IMs contacted had recently been through training sessions covering procedures for handling FMS requisitions. Although the IMs considered the training beneficial, they did admit that they were still unclear as to the correct action to be taken in certain supply situatins. The IMs also admitted that, based on what they had learned in their recent training sessions, they had been mishandling FMS requisitions in the past.

Conflicting Guidance

The majority of the IMs perceived their governing directives and management guidance to be conflicting and or confusing in the area of FMS requisitions. For example, although the IMs appeared to clearly understand the requirements of programmed and nonprogrammed requisitions, several stated that they were instructed to give preference to nonprogrammed requisitions which contained a NMCS indicator or a high issue priority designator. This preference was provided at the expense of programmed requisitions.

An example of where guidance from management overrode policy involved a country which had a FMSO I stock level of 23 for a specific NSN. The country received an emergency Time Compliance Technical Order (TCTO) from the USAF weapon system manager which applied to this NSN. Within an eleven-day period, the country submitted four requisitions for a total quantity of fifty items. The IM was aware that the requisitioned quantity substantially exceeded the country's FMSO I level and requested guidance from higher level management. The IM was instructed to fill the total quantity requisitioned even though this action completely depleted the stock level. Subsequent programmed demands then had to be placed on backorder.

Direct Shipment Procurement Actions

Several IMs cited problems associated with Direct Shipment procurement actions as a contributing factor to relatively poor fill times for programmed requisitions when compared with nonprogrammed requisitions. An IM often handles a programmed requisition with a Direct Shipment procurement action when his assets are below the support level. A Direct Shipment procurement action involves an arrangement with a contractor to ship the item directly to the customer country upon its manufacture. In these cases, the programmed requisition is lead time away. The problem arises when, if during the production lead time cycle,

additional serviceable assets become available to the IM. Because he tends to "forget about" backorders that are being handled via Direct Shipment procurement actions or does not want to expend the effort to revise the Direct Shipment procurement action, the programmed requisition is left to be filled lead time away. Subsequent nonprogrammed requisitions received by the IM may be filled from stock because of additional serviceable assets received. Several IMs stated that the administrative efforts required to change a Direct Shipment procurement are so involved that such actions are not usually considered. Further, several IMs stated that they do not have the resources to manually monitor all backordered programmed requisitions to prevent the fill time problems that the example above illustrates.

Excessive NMCS Requisitions

The IMs contacted noted a relatively high percentage of FMS requisitions coded with NMCS indicators. The IMs stated that it appeared, in some cases, that the NMCS indicators were used by FMS customers to accelerate delivery and may not have represented actual NMCS conditions. This situation is significant because the majority of the IMs interviewed stated that consideration is made to fill nonprogrammed NMCS requisitions down to the zero asset level.

Other Variables in the Requisition

We learned through the interviews with the IMs that occasionally there are other variables on the country-submitted requisitions which impact on fill times. For example, an entry of a "T" in the Advice Code field of the requisition indicates that the country requires that the requisition be filled only with a new or unused asset. If a programmed requisition is coded with a "T" in the Advice Code field, it can only be filled from stock if the IM has new or unused assets. Thus, a programmed requisition with a "T" Advice Code could very well be backordered whereas a comparable nonprogrammed requisition, not having a "T" Advice Code, could be filled from stock.

IM's Misconceptions

Although we were impressed with the IM's basic understanding of the CLSSA program, we did encounter some misconceptions relative to the procedures of filling requisitions and buying FMSO I assets. There appeared to be a definite tendency to fill NMCS coded requisitions over programmed requisitions. Specifically, one IM stated that she had been instructed to fill nonprogrammed requisitions with NMCS indicators. Another misconception that we encountered was the opinion of one IM that he could not order the FMSO I level until one year after the FMSO I case was established. Under such circumstances, a country would have

to wait two years or more before it could benefit from its FMSO I stock level.

Erroneous Shipment Notification

One IM stated that she experienced an occasional problem with shipment notifications. Specifically, she would be notified that an item had been shipped, only to find at some future date (usually weeks or months later), that the item had not actually been shipped. This erroneous shipment notification would cause her to stop her normal monitoring process for that requisition and would result in a substantially increased fill time.

Modifications

Several IMs commented that one reason for fast fill times for some nonprogrammed requisitions involved modifications of USAF weapon systems. Frequently, a modification will involve replacing an item with a new component across the total weapon system inventory of the USAF. The asset level for the replaced item then becomes excessive. In this situation, all FMS requisitions for the item being replaced, including nonprogrammed requisitions, could be filled immediately from stock.

Summary

In this chapter the results of conducting the statistical tests on the two sample data bases of programmed

and nonprogrammed requisitions were presented. Also discussed were the results of our interviews with a number of IMs. These interviews were conducted to set an understanding of the IM's knowledge of the supply policies regarding the support of programmed requisitions. Based on the interviews, we are able to highlight a number of problem areas that the IMs have experienced in providing timely support for programmed requisitions. Our final chapter will summarize the results of our findings and present a number of recommendations.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The objective of this thesis was to investigate the supply effectiveness received by programmed requisitions submitted under the CLSSA program. In this chapter the specific research objectives of our thesis initially defined in Chapter I are reviewed. The results of the statistical analysis and the IM survey conducted in support of our research objectives are summarized. Finally, specific recommendations based upon our findings are presented. Some of these recommendations are identified as possible future thesis research topics.

Conclusions

In order to evaluate the supply effectiveness aspects of the CLSSA program, five specific research objectives were established. Each of these research objectives are redefined below along with a summary discussion regarding our efforts against each of these objectives.

Objective 1

Objective 1: To provide an explanation of the supply aspects of the CLSSA program.

In Chapter II the purposes, participants, and principal elements of the CLSSA program were described.

The relationship between the FMSO I stock level case and the FMSO II requisition case were explained. The route taken by a country submitted requisition through the HO51 and DO32 systems was outlined. The concepts of programmed and nonprogrammed requisitions were explained in detail. Finally, the factors that determine when a FMS requisition is filled were presented.

Objective 2

Objective 2: To test the hypothesis that programmed requisitions for AF investment items do, in fact, receive faster processing time than similar nonprogrammed requisitions.

In Chapter IV the results of the T-tests provided information regarding the differences between the fill times for programmed and nonprogrammed requisitions. For both of the samples evaluated the mean fill time for the programmed requisitions was found to be statistically less than for comparable nonprogrammed requisitions.

Objective 3

Objective 3: To test the hypothesis that programmed NMCS requisitions for AF investment items do, in fact, receive faster processing time than similar nonprogrammed NMCS requisitions.

The differences in the mean fill times for NMCS coded requisitions indicated a better fill time for the

programmed requisitions. The difference for the March data, however, were so small that the means could not be considered statistically different at a .05 significance level. Based on the data and our analysis, we conclude that a country submitted NMCS requisition does not appear to receive better support if it is also coded as programmed.

Objective 4

Objective 4: If objectives 2 and 3 are supported, to quantify the magnitude of the improved support.

The magnitude of the improved support for programmed requisitions compared to nonprogrammed requisitions was 73.9 days (March sample) and 102.2 days (June sample) using the differences of the means of the two samples. Though these differences proved to be statistically different, they fall far short of our criterion test of 330 days as defined in Chapter III. Because the differences did not pass the criterion test, it was necessary for us to act on our Objective 5.

Objective 5

Objective 5: If objectives 2 and 3 cannot be supported, to determine why the AFLC logistics system is failing to provide a better level of support for programmed requisitions.

The answer to Objective 5 was based upon discussions held with a number of Item Managers (IMs). Our selection of

IMs was determined by the criteria outlined in Chapter III. The responses of the IMs to our specific questions along with their comments on problems with FMS requisitions established a foundation for determining why the AFLC logistic system is failing to provide a better level of support for programmed requisitions. As a result of our discussions with the IMs, we identified eight interest areas:

1. Training
2. Conflicting guidance
3. Direct shipment procurement actions
4. Excessive NMCS requisitions
5. Other variables on the requisition
6. IM misconceptions
7. Erroneous shipment notifications
8. Weapon system modifications.

While the above list is not all-inclusive, it does identify areas of interest which contribute to an explanation of why the logistics system is not meeting the support expectations of programmed requisitions.

Recommendations

Based upon the findings of our research, the following four specific recommendations are presented:

1. ILC personnel should review this study, including the associated assumptions.

2. ILC personnel should become familiar with the mechanics of the computer programs developed in order to periodically replicate the statistical analysis. Modifications to the programs can be easily made in the event a special analysis of programmed versus nonprogrammed support is required. For example, a simple program modification could provide personnel in the ILC with a management tool to examine the fill times for a particular geographic region or a specific country.

3. The ILC should institute a monitoring of the percentage of FMS requisitions that contain an NMCS indicator. This monitoring should be done on a country-by-country basis to ensure that no FMS customer is overusing the NMCS indicator to obtain accelerated support at the expense of programmed requisitions.

4. The ALC should provide continuous quality training to the IMs relative to the correct procedures for processing FMS and, particularly, CLSSA programmed requisitions. It is the IM that can make the system work correctly.

In addition to the four specific recommendations above, three research topics attendant to the CLSSA program are postulated.

Survey

Though statistical measures of a program's effectiveness are important for the management of a program, a true assessment of a program should involve feedback from the users of the program. In the case of the CLSSA program, the perceptions of the participating countries should be considered in assessing the success of the program. A survey of the participating countries to obtain their thoughts on how well the program is working from their perspective should be made.

The survey should attempt to measure: (1) how well the participating countries understand the mechanics of CLSSA, and (2) how they rate the support that their programmed requisitions have been receiving. The survey should also identify specific problems that specific countries are experiencing. A survey, conducted on an annual basis, could be used to help assess whether the supply support is improving or is becoming less satisfactory over time.

Simulation Modelling

Fill times of FMS requisitions are a function of a complex relationship of a number of dynamic variables--programmed versus nonprogrammed, priority, NMCS indicator, quantity, assets on hand, assets on order, assets due in from maintenance, number of outstanding backorders, etc. To obtain an understanding of the fill time distribution,

a simulation model of the supply process could be formulated.

Beer summarizes the advantage of simulation as threefold: (1) simulation provides artificial experience of the real system very much more quickly than it could otherwise be obtained; (2) the experience is gained without running any risk; and (3) it is even possible to alter the system as it is now, to see what would be likely to happen under a new type of policy. Simulations can tell us what would happen if (1:231-232).

A simulation model of the CLSSA program could allow ILC personnel to evaluate proposed policy or procedural changes to the program prior to actual implementation of the changes. In addition, the impacts associated with major new additions to the program could be assessed.

FMSO I--Evaluation of Requirements Forecasting

An important step in developing a responsive CLSSA program is in the area of forecasting requirements for the establishment of the initial FMSO I recommendation list. Inaccurate forecasting of requirements would result in the following conditions:

1. Items would be placed on the FMSO I against which the country would incur a financial expense but have no requirement for. This situation is particularly

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A STATISTICAL ANALYSIS TO DETERMINE THE SUPPLY EFFECTIVENESS OF--ETC(U)
SEP 79 J R CALLAHAN , C E JOHNSON

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burdensome to the country because the country has reduction-deletion responsibilities (21:4-1).

2. Items would be omitted from the FMSO I for which replenishment is necessary. This replenishment would have to be satisfied on a nonprogrammed basis until the one-year limit passes.

3. The level on the FMSO I would be excessive or insufficient.

Presently no evaluation is made of the correlation between the requirements recommended for the FMSO I and the actual demands that the country experiences during the initial follow-on support phase. Such an evaluation could be used to detect those methods of requirements forecasting which prove to be more accurate than others.

Final Summary

This thesis met the objectives enumerated in Chapter I. A computerized procedure for evaluating the supply effectiveness of programmed requisitions was developed and documented. The results of the fill time hypotheses were not favorable when compared to the contended improvement in supply that is advertised for programmed requisitions. Issues have been identified that require further investigation. It is hoped that this research will initiate action to improve the CLSSA program--to make it more effective.

APPENDICES

APPENDIX A

LISTING OF PROGRAM USED TO EXTRACT THE REQUISITION DATA AND BUILD DATA BASE

Listing of Program

```
IDENT   WP1186,AFIT-79B-CALLAHAN 72498    TFILL
COBOL
PRMFL   C*,W,S,MIXX/FILL.O
REMOTE  $$,AC
REMOTE  P*,AC
IDENTIFICATION DIVISION.
PROGRAM-ID. LDROFI.
AUTHOR. JIM CALLAHAN .
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER. GE-635.
OBJECT-COMPUTER. GE-635.
INPUT-OUTPUT SECTION.
FILE CONTROL.
    SELECT LDRO ASSIGN TO II.
    SELECT REQFILE ASSIGN TO RF.
    SELECT PRINT ASSIGN TO PP FOR LISTING.
I-O-CONTROL.
    APPLY STANDARD FORMAT ON LDRO PRINT REQFILE.
DATA DIVISION.
FILE SECTION.
FD  REQFILE
    LABEL RECORDS STANDARD   DATA RECORD IS REQ-OUT.
01  REQ-OUT.
    03 PRGM-O            PIC 9B.
    03 FILLTIME-O        PIC ZZZ9B.
    03 IP-O              PIC 99B.
    03 NORS-O            PIC 9B.
    03 QTY-O             PIC ZZZZ99.
```

Listing of Program--continued

```
FD  LDRO
    LABEL RECORDS STANDARD
    DATA RECORD IS LDRO-REC.
01  LDRO-REC.
    03 FILLER              PIC X(7).
    03 NSN                 PIC X(13).
    03 FILLER              PIC X(4).
    03 QTY                 PIC S9(5).
    03 DOC-NO.
       04 SERV             PIC X.
       04 COUNTRY          PIC XX.
       04 FILLER           PIC X(11).
    03 DEMAND              PIC X.
    03 FF                  PIC XXX.
    03 CASE                PIC XXX.
    03 FILLER              PIC X(9).
    03 IP                  PIC 99.
    03 NORS                PIC X.
    03 RAD                 PIC XX.
    03 AS                  PIC XX.
    03 PROCESS             PIC X.
    03 DEL-QTY             PIC S9(5).
    03 PRICE               PIC S9(6)V99.
    03 OCC                 PIC X.
    03 FOL-UP              PIC XXX.
    03 ESD                 PIC 999.
    03 PDATE.
       04 PYR              PIC 9.
       04 PDAY             PIC 999.
    03 BADATE.
       04 BAYR             PIC 9.
       04 BADAY            PIC 999.
    03 FILLER              PIC X(5).
    03 BOQTY               PIC X(5).
    03 ASIQTY              PIC X(5).
    03 BAQTY               PIC S9(5).
    03 SHIPQTY             PIC S9(5).
    03 SHIPDATE.
       04 SHIPYR           PIC 9.
       04 SHIPDAY          PIC 999.
    03 FILLER              PIC X(3).
    03 ERRC                PIC X.
    03 BUDGET              PIC X.
    03 ESD-YR              PIC 9.
    03 OVALUE              PIC S9(8)V99.
    03 PCODE               PIC X.
    03 FILLER              PIC X(17).
FD  PRINT
    LABEL RECORDS STANDARD      DATA RECORD IS OUT-LINE.
01  OUT-LINE.
    03 FILLER              PIC X(132).
```

Listing of Program--continued

```
      WORKING-STORAGE SECTION.
      77  ICNT                    PIC 9(6) COMP-1.
      77  QCNT                    PIC 9(6) COMP-1.
      77  TCNT                    PIC 9(6) COMP-1.
      77  BOCNT                   PIC 9(6) COMP-1.
      77  PCNT                    PIC 9(6) COMP-1.
      77  FILLTIME                PIC 9(6) COMP-1.
      77  SUPPLY-PER              PIC 99V999 COMP-2.
      77  SHIP-PER                PIC 99V999 COMP-2.
      77  FT1                     PIC 9(6) COMP-1.
      77  FT2                     PIC 9(6) COMP-1.
      77  NPCNT                   PIC 9(6) COMP-1.
      77  NSNCNT                  PIC 9(6) COMP-1.
      77  LCNT                    PIC 9(6) COMP-1.
      77  FCNT                    PIC 9(6) COMP-1.
      77  OCNT                    PIC 9(4) COMP-1.
      77  NCNT                    PIC 9(6) COMP-1.
      77  I   PIC 99 COMP-1.
      77  HOLD                    PIC ZZZ,ZZ9.
      77  HOLD2                   PIC Z.999.
      77  JHOLD                    PIC Z9.
      77  J   PIC 99 COMP-1.
      77  PRGM                    PIC 9.
      77  NPRGM                   PIC 9.
      77  NSNH                    PIC X(13).
      01  CNTS.
          03 MATCH  PIC 9(4) COMP-1 OCCURS 10 TIMES.
      01  TAPE-DATE.
          03 TYR                  PIC 9.
          03 TDAY                 PIC 999.
          03 FILLER               PIC X.
          03 DATE-P               PIC X(10).
      01 NSN-ARRAY.
         02 FILLER OCCURS 99 TIMES.
          03 COUNTRY-T            PIC XX.
          03 FILLTIME-T           PIC 9(4) COMP-1.
          03 QTY-T                PIC S9(5).
          03 PRICE-T              PIC S9(6)V99.
          03 CASE-T               PIC XXX.
          03 IP-T                 PIC 99.
          03 NORS-T               PIC X.
          03 RAD-T                PIC XX.
          03 PDATE-T              PIC X(4).
          03 BADATE-T             PIC X(4).
          03 PCODE-T              PIC X.
          03 DOC-NO-T             PIC X(14).
          03 BAQTY-T              PIC S9(5).
          03 SHIPDATE-T           PIC X(4).
          03 SHIPQTY-T            PIC S9(5).
```

Listing of Program--continued

```
01  H1.
    03 FILLER              PIC X(10) VALUE SPACES.
    03 FILLER              PIC X(80) VALUE
*   CLSSA NSN REQUISITON ANALYSIS".
01  H2.
    03 FILLER VALUE "    NSN" PIC X(13).
    03 FILLER              PIC X(80) VALUE
"COUNTRY  QTY CASE PRI NORS COST   PROCESS SUPPLY CLSSA FILL".
01  H3.
    03 FILLER VALUE SPACES PIC X(49).
    03 FILLER              PIC X(40) VALUE
"DATE  DATE   INDIC TIME".
01  L1.
    03 NSN-L1              PIC X(16).
    03 COUNTRY-L1          PIC XXX.
    03 QTY-L1              PIC Z(5)BBB.
    03 CASE-L1             PIC X(4).
    03 IP-L1               PIC 99BB.
    03 NORS-L1             PIC X.
    03 RAD-L1              PIC XX.
    03 PRICE-L1            PIC $$$,$$$.99B.
    03 PDATE-L1            PIC X(7).
    03 BADATE-L1           PIC X(8).
    03 PCODE-L1            PIC XXX.
    03 FILLTIME-L1         PIC ZZZ9B.
    03 SHIPDATE-L1         PIC X(5).
    03 BAQTY-L1            PIC Z(4)9B.
    03 SHIPQTY-L1          PIC Z(4)9B.
```

Listing of Program--continued

```
PROCEDURE DIVISION.
OPEN-T.
    OPEN INPUT LDRO OUTPUT PRINT REQFILE.
    ACCEPT TAPE-DATE.   DISPLAY TAPE-DATE.
READ-TAPE.
    READ LDRO AT END GO TO CLOSE-9.
    ADD 1 TO TCNT.
    IF BADATE = SPACES AND SHIPDATE = SPACES ADD 1 TO BOCNT
        GO TO READ-TAPE
        ELSE ADD 1 TO FCNT.
    IF COUNTRY = 'IR' GO TO READ-TAPE.
    IF QTY > 50 ADD 1 TO QCNT GO TO READ-TAPE.
    IF FCNT = 1 MOVE NSN TO NSNH GO TO NEXT-NSN.
    IF NSN NOT = NSNH GO TO TEST-ARRAY.
NEXT-NSN.
    IF PCODE = '6' MOVE 1 TO PRGM ADD 1 TO PCNT
        ELSE MOVE 1 TO NPRGM ADD 1 TO NPCNT.
    ADD 1 TO I.  IF I > 98 DISPLAY 'OVERFLOW' GO TO CLOSE-9.
    IF SHIPQTY = QTY GO TO USE-SHIP-DATE.
    IF SHIPDATE = SPACE OR SHIPQTY = 0
        GO TO USE-SUPPLY-DATE.
    IF BAQTY = 0 GO TO USE-SHIP-DATE.
PRORATION-LOGIC.
    COMPUTE FT1 = BADAY - PDAY + 10
         + ((BAYR - PYR) * 365).
    IF FCNT < 99 DISPLAY 'SHIP DATE LOGIC'.
    COMPUTE FT2 = SHIPDAY - PDAY
        + ((SHIPYR - PYR) * 365).
    COMPUTE SUPPLY-PER = BAQTY / QTY.
    COMPUTE SHIP-PER = 1 - SUPPLY-PER.
    COMPUTE FILLTIME = SUPPLY-PER * FT1
        + SHIP-PER * FT2.
    GO TO FILL-ARRAY.
USE-SHIP-DATE.
    COMPUTE FILLTIME = SHIPDAY - PDAY
        + ((SHIPYR - PYR) * 365).
    GO TO FILL-ARRAY.
USE-SUPPLY-DATE.
    COMPUTE FILLTIME = BADAY - PDAY + 10
        + ((BAYR - PYR) * 365).
```

Listing of Program--continued

```
FILL-ARRAY.
    MOVE QTY TO QTY-T (I).
    MOVE FILLTIME TO FILLTIME-T (I).
    IF FILLTIME > 599 MOVE FILLTIME TO HOLD
        MOVE SUPPLY-PER TO HOLD2
     DISPLAY QTY BAQTY SHIPQTY ' ' PDATE ' ' BADATE ' ' SHIPDATE
        HOLD HOLD2.
    MOVE 0 TO FILLTIME FT1 FT2.
    MOVE CASE TO CASE-T (I).
    MOVE COUNTRY TO COUNTRY-T (I).
    MOVE IP TO IP-T (I).
    MOVE NORS TO NORS-T (I).
    MOVE RAD TO RAD-T (I).
    MOVE PRICE TO PRICE-T (I).
    MOVE BADATE TO BADATE-T (I).
    MOVE PCODE TO PCODE-T (I).
    MOVE PDATE TO PDATE-T (I).
    MOVE SHIPDATE TO SHIPDATE-T (I).
    MOVE BAQTY TO BAQTY-T (I).
    MOVE SHIPQTY TO SHIPQTY-T (I).
    MOVE DOC-NO TO DOC-NO-T (I).
    GO TO READ-TAPE.
TEST-ARRAY.
    ADD 1 TO NSNCNT.
    IF PRGM = 1 AND NPRGM = 1 MOVE 1 TO J ADD 1 TO NCNT
        PERFORM ARRAY-WRITE I TIMES
        MOVE ALL '_ ' TO OUT-LINE WRITE OUT-LINE AFTER 2
        ADD 1 TO LCNT.
    MOVE NSN TO NSNH.
    IF I < 10 ADD 1 TO MATCH (I).
    MOVE 0 TO PRGM NPRGM I FILLTIME.
    GO TO NEXT-NSN.
```

Listing of Program--continued

```
ARRAY-WRITE.
    ADD 1 TO OCNT.
    MOVE FILLTIME-T (J) TO FILLTIME-O FILLTIME-L1.
    MOVE QTY-T (J) TO QTY-O QTY-L1.
    MOVE IP-T (J) TO IP-O IP-L1.
    IF NORS-T (J) = "N" OR "E" MOVE 1 TO NORS-O
        ELSE MOVE 2 TO NORS-O.
    IF PCODE-T (J) = "6" MOVE 1 TO PRGM-O ELSE MOVE 2 TO PRGM-O.
    IF OCNT < 9 DISPLAY REQ-OUT.
    WRITE REQ-OUT.
    MOVE NSNH TO NSN-L1.  MOVE NORS-T (J) TO NORS-L1.
    MOVE PCODE-T (J) TO PCODE-L1.
    MOVE COUNTRY-T (J) TO COUNTRY-L1.
    MOVE CASE-T (J) TO CASE-L1.
    MOVE PRICE-T (J) TO PRICE-L1.
    MOVE PDATE-T (J) TO PDATE-L1.
    MOVE RAD-T (J) TO RAD-L1.
    MOVE BADATE-T (J) TO BADATE-L1.
    MOVE SHIPDATE-T (J) TO SHIPDATE-L1.
    MOVE BAQTY-T (J) TO BAQTY-L1.
    MOVE SHIPQTY-T (J) TO SHIPQTY-L1.
    IF LCNT = 0 WRITE OUT-LINE FROM H1 AFTER TOP
        WRITE OUT-LINE FROM H2 AFTER 2
        WRITE OUT-LINE FROM H3 AFTER 1.
    ADD 1 TO LCNT. IF LCNT > 22 MOVE 0 TO LCNT.
    WRITE OUT-LINE FROM L1 AFTER 2.
    ADD 1 TO J.
CLOSE-9.
    MOVE TCNT TO HOLD. DISPLAY "# OF TAPE READS=" HOLD.
    MOVE FCNT TO HOLD. DISPLAY "# OF FILL READS=" HOLD.
    MOVE BOCNT TO HOLD. DISPLAY "# OF BO READS=" HOLD.
    MOVE QCNT TO HOLD. DISPLAY "# OF QTY EDITS=" HOLD.
    MOVE PCNT TO HOLD. DISPLAY "# OF PRGM READS=" HOLD.
    MOVE NPCNT TO HOLD. DISPLAY "# OF NPRGM READS=" HOLD.
    MOVE NSNCNT TO HOLD. DISPLAY "# OF NSN READS=" HOLD.
    MOVE 1 TO J.  PERFORM MOVE-MATCH 10 TIMES.
    MOVE NCNT TO HOLD.
     DISPLAY "# OF NSNS WITH BOTH PRGM & NONPRGRM="
        HOLD.
    MOVE OCNT TO HOLD. DISPLAY "# OF REQ WRITES=" HOLD.
    CLOSE LDRO PRINT REQFILE.   STOP RUN.
MOVE-MATCH.
    MOVE MATCH (J) TO HOLD. MOVE J TO JHOLD.
    DISPLAY "MATCH-" JHOLD HOLD.  ADD 1 TO J.
ENDJOB
```

Control Cards to Execute Program

```
$       IDENT   WP1186,AFIT-79B-CAL  74144      TFILL.T
$       OPTION  NOMAP
$       SELECT  MIXX/FILL.O
$       EXECUTE
$       LIMITS  15,14K,,5K
$       REMOTE  P*,AC
$       REMOTE  $$,AC
$       REMOTE  PP,AC
$       TAPE    II,X4D,,70670,,JUNES
$       PRMFL   RF,W,S,MIXX/FILLJULY
$       ENDJOB
```

APPENDIX B

LISTING OF PROGRAMS USED IN ANALYSIS

Frequencies Directive

```
$       IDENT    WP1186,AFIT-79B-CALLAHAN      TFREQ
$       SELECT   SPSS/SPSS
RUN NAME         FMS FILL TIME STATISTICS
TASK NAME        DESCRIPTIVE STATISTICS
VARIABLE LIST    PRGM,FILLTIME,PRI,NORS,QTY
INPUT FORMAT     FREEFIELD
INPUT MEDIUM     CARD
N OF CASES       275
VAR LABELS       PRGM,PROGRAMMED INDICATOR
VALUE LABELS     PRGM (1) PROGRAMMED (2) NONPROGRAMMED
SELECT IF        (PRGM EQ 1)
*RECODE          FILLTIME(0 THRU 30=1)(31 THRU 60.=2)(61 THRU 90.=3)
                 (91 THRU 120.=4)(121 THRU 150.=5)(151 THRU 180.=6)
                 (181 THRU 210=7)(211 THRU 240=8)(241 THRU 270=9)
                 (271 THRU 300=10)(301 THRU 330=11)(331 THRU 360=12)
                 (361 THRU 390=13)(391 THRU 420=14)(421 THRU 450=15)
                 (451 THRU 480=16)(481 THRU 510=17)(511 THRU 9999=18)
VALUE LABELS     FILLTIME (1) 15 DAYS (2) 45 DAYS (3) 75 DAYS
                 (4) 105 DAYS (5) 135 DAYS (6) 165 DAYS (7) 195 DAYS (8) 225 DAYS
                 (9) 255 DAYS (10) 285 DAYS (11) 315 DAYS (12) 345 DAYS
                 (13) 375 DAYS (14) 405 DAYS (15) 435 DAYS
                 (16) 465 DAYS (17) 495 DAYS (18) 525 DAYS
FREQUENCIES      INTEGER=FILLTIME(0,18)
OPTION           8
STATISTICS       ALL
READ INPUT DATA
$       SELECTA FILLJULY
FINISH
$       ENDJOB
```

Descriptive Statistics Directive

```
$       IDENT   WP1186,AFIT-     79B-CALLAHAN      TSTAT
$       SELECT  SPSS/SPSS
RUN NAME        FMS FILL TIME STATISTICS
TASK NAME       DESCRIPTIVE STATISTICS
VARIABLE LIST   PRGM,FILLTIME,PRI,NORS,QTY
INPUT FORMAT    FREEFIELD
INPUT MEDIUM    CARD
N OF CASES      275
VAR LABELS      PRGM,PROGRAMMED INDICATOR
VALUE LABELS    PRGM (1) PROGRAMMED (2) NONPROGRAMMED
SELECT IF       (PRGM EQ 2)
FREQUENCIES     INTEGER=FILLTIME(0,1250)
OPTION          7
STATISTICS      ALL
READ INPUT DATA
$       SELECTA FILLJULY
FINISH
$       ENDJOB
```

T-Test Directive

```
$       IDENT    WP1242,AFIT- 79B-CALLAHAN     TTEST
$       SELECT   SPSS/SPSS
RUN NAME         FMS FILL TIME STATISTICS
TASK NAME        T-TEST
N OF CASES       275
VARIABLE LIST    PRGM,FILLTIME,PRI,NMCS,QTY
INPUT FORMAT     FREEFIELD
INPUT MEDIUM     CARD
VAR LABELS       PRGM,PROGRAMMED INDICATOR
VALUE LABELS     PRGM (1) PROGRAMMED (2) NONPROGRAMMED
T-TEST           GROUPS=PRGM(1,2)/VARIABLES=FILLTIME,QTY,PRI,NMCS/
READ INPUT DATA
$       SELECTA FILLJULY
FINISH
$       ENDJOB
```

Plot Commands

```
800IDEN MIXX-CALLAHAN 74144  TPLOT
810FILE 01,5,17
815PAGE 10.0,7.5
816DASH 1
820TLAB FMS FILL TIMES - MARCH DATA
830BLAB PROGRAMMED VS. NONPROGRAMMED
840XLAB DAYS
850YLAB PERCENT FILLED
860SCAL 0,500,0,100
870ATIC 50,10
880XCOL 1,1,17
890YCOL 2,1,17,3,1,17
900PLOT
910BLAB NMCS REQUISITIONS - PROGRAMMED VS. NONPROGRAMMED
920YCOL 4,1,17,5,1,17
930PLOT
940FILE 02,5,17
950TLAB FMS FILL TIMES - JUNE DATA
960BLAB PROGRAMMED VS. NONPROGRAMMED
970XLAB DAYS
980YLAB PERCENT FILLED
990SCAL 0,500,0,100
1000ATIC 50,10
1010XCOL 1,1,17
1020YCOL 2,1,17,3,1,17
1030PLOT
1040BLAB NMCS REQUISITIONS - PROGRAMMED VS. NONPROGRAMMED
1050YCOL 4,1,17,5,1,17
1060PLOT
1070STOP
1080$  DATA    01
1090$15,52.9,31.2,61.5,43.8
1100$45,59.3,38.2,67.7,50.0
1110$75,65.7,45.7,73.8,56.3
1120$105,68.9,49.2,73.8,56.3
1130$135,71.8,55.3,78.5,71.9
1140$165,72.9,56.8,80.0,71.9
1150$195,73.2,57.8,80.0,75.0
1160$225,74.3,62.3,80.0,78.1
1170$255,75.4,65.3,81.5,81.3
1180$285,76.8,66.8,83.1,81.3
1190$315,77.1,68.8,83.1,84.4
1200$345,78.6,70.9,83.1,84.4
1210$375,78.6,74.4,83.1,84.4
1220$405,80.0,76.4,83.1,87.5
1230$435,81.1,77.4,83.1,87.5
1240$465,82.1,78.4,86.2,90.6
1250$495,84.6,80.9,90.8,93.8
```

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